Table of contents

Instruction: W0010035

:
: 0 001 133 ..

Continue: I01

TABLE OF CONTENTS

Continue: I01/1

SPECIAL FEATURES

These instructions describe repair operations for the following pre-engaged-drive starting motors of type DA

- 12 V/0.9 kW 0 001 133 ...

This type of starting motor features an axial seal in the drive-end bearing and a thrust ring at the collar of the meshing pinion.
More recent versions are provided with a radial-lip-type oil seal in the drive-end bearing and are dealt with in separate instructions.

Continue: I02/2

SPECIAL FEATURES

A new parts set is always to be used on assembly.

Lubricate in line with lubrication schedule before and during assembly.

Prior to assembly, use three-square scraper to remove all residual paint from fitting and sealing surfaces.

Continue: I03/1

SPECIAL FEATURES

If the starting motor is painted after assembly, make sure that paint does not ingress into the interior of the starting motor through the vent holes.
Seal vent holes before painting.

Always re-open vent holes after painting to ensure proper operation of starting motor.

Continue: I03/2

SPECIAL FEATURES

The overrunning-clutch drive is subject to a high degree of wear and is always to be replaced.

The bushings in the drive-end bearing and commutator end shield are always to be renewed.

Continue: I04/1

SPECIAL FEATURES

There is no means of checking the solenoid switch which would provide reliable information on long-term trouble-free operation.

It is therefore advisable to renew the solenoid switch when repairing the starting motor.

On installation, approx. 0.5 g of Loctite 577 (5 994 090 000) is to be applied to the threads of the solenoid switch bolts.

Continue: I04/2

SPECIAL FEATURES

Starting motors of this type have various vehicle-specific drive-end bearings which may differ considerably from the version illustrated. This however in no way affects disassembly, checking, repair and assembly.

Continue: I01/1

STRUCTURE, USAGE

PC user prompting:
Position cursor on button and confirm.
Microcard user prompting:
User prompting is provided on every page e.g.:
- Continue: I 17/1
- Continue: II 18/1 Fig.: II 17/2

Brief instructions may include several rows of coordinates.
I../. = first coordinate row
II../. = second coordinate row
III../. = third coordinate row
etc.

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: I01/1

GENERAL

Unless otherwise stated, the voltages indicated in these instructions are DC voltages.
AC voltages are marked by the symbol " * ".

Continue: I06/2

GENERAL

Expert repairs are only possible using the prescribed tools and measuring instruments, which are in perfect working order. We therefore recommend that exclusive use be made of the tools listed.

The use of incorrect and unsuitable tools and testers can lead to injury and may damage the product concerned or its component parts.

Continue: I07/1

GENERAL

Only use replacement parts given in the service parts list for the starting motor concerned.

Proper functioning presupposes use of the lubricants specified in these instructions, both prior to and during assembly.

Absolute cleanliness is to be ensured when performing repair work.

Continue: I01/1

SAFETY MEASURES

Component cleaning:
Armature, commutator end shield, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Use is never to be made of liquid cleaning agents.

Other parts such as stator frame and drive-end bearing can be washed out with commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours. Components must be re-lubricated or re-greased in line with lubrication schedule.

Continue: I08/2

SAFETY MEASURES

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Always use the listed tools. Injuries cannot be precluded if use is made of incorrect and unsuitable tools and testers.

Continue: I09/1

SAFETY MEASURES

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: I09/2

SAFETY MEASURES

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTERS, EQUIPMENT, TOOLS

All tools required for repairing starting motors of type DA are listed in the following.

Some of the tools needed have to be improvised in line with the drawings.

The type designation is given in parentheses for tools which used to be ordered on this basis.

Continue: I10/2

TESTERS, FIXTURES, TOOLS

Interturn short-circuit tester with test probes:	0 986 619 110
Test prods:	0 986 619 101
(Old version:	0 986 619 114)
Alternator tester WPG 012.00:	0 684 201 200
(alternatively, Motortester)	
Magnetic measurement stand:	4 851 601 124
Dial indicator:	1 687 233 011
Mandrel press:	comm. avail.

Continue: I11/1

TESTERS, EQUIPMENT, TOOLS

Clamping support:	0 986 619 362 (KDAW 9999)
Torque wrench (0...70 Nm):	comm. avail.
Torque meter (0.15...0.80 Nm):	0 986 617 206 (KDAL 5485)
Assembly sleeve:	0 986 619 417
Disassembly sleeve:	0 986 619 418

Continue: I11/2

TESTERS, EQUIPMENT, TOOLS

Pressing-on tool for pinion with 8 teeth:	0 986 619 403
Holding fixture:	0 986 619 420
Collet chuck, comprising	
* Clamping fixture for body:	0 986 619 408
* Collet chuck for pinion with 8 teeth:	0 986 619 409

Continue: I12/1

TESTERS, EQUIPMENT, TOOLS

Bushing puller:	0 986 617 243 (KDAL 5493)
Spring collet for bushings diameter 12.5 mm:	0 986 617 246 (KDAL 5493/0/3)
Pressing-in mandrel with plate washer for bushings diameter 12.5 mm:	0 986 617 212 (KDAL 5486)

Continue: I12/2

TESTERS, EQUIPMENT, TOOLS

Tailstock chuck with Morse taper 2 for clamping diameter 5...45 mm for holding armature when turning down:	0 986 619 156 (KDAW 9987)
Vernier caliper:	comm. avail.
Three-square scraper:	comm. avail.
Small cape chisel:	comm. avail.

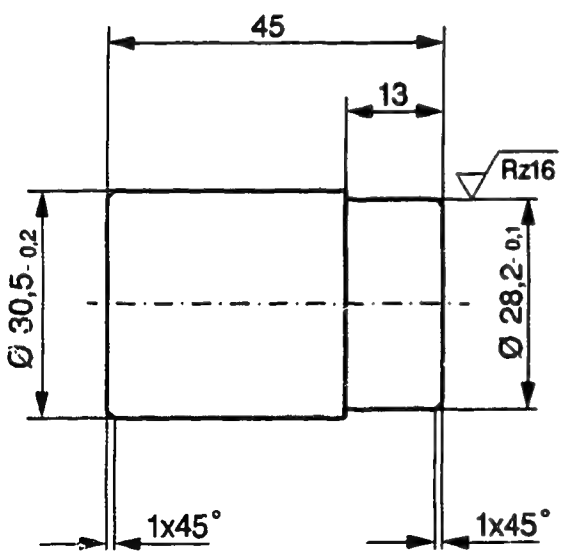
Continue: I13/1

TESTERS, EQUIPMENT, TOOLS

**Pressing-out mandrel
for bushing
in drive-end bearing: to be improvised**

Continue: I14/1 Fig.: I13/2

KMS00454

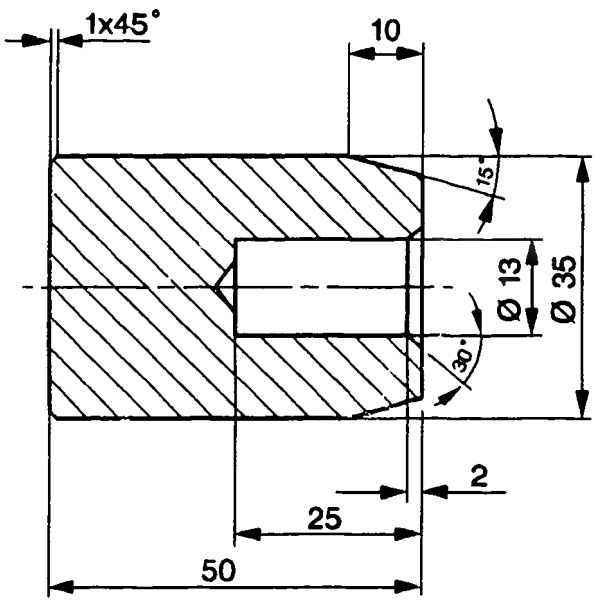


Rz63 (Rz16)

Centering sleeve for brush holder: Own make

Continue: I01/1 Fig.: I14/2

KMS00457



√Rz63

TEST SPECIFICATIONS AND SETTINGS

Commutator - minimum diameter:	33,5 mm
Radial run-out - Commutator:	< 0,02 mm
Armat. axial clearance:	0,1...0,6 mm

Continue: I15/2

TEST SPECIFICATIONS AND SETTINGS

Armature braking torque:	0,3...0,4 Nm
Clutch overrunning torque:	0,1...0,2 Nm
Carbon brush wear dimension x:	< 14 mm
Total pinion travel a:	12...15 mm

Continue: I16/1

TEST SPECIFICATIONS AND SETTINGS

Solenoid-switch pull-in voltage:	**5...8 V**

Solenoid-switch resistances

- Pull-in winding:	**0,3...0,4 Ohm**
- Holding winding:	**1,5...1,7 Ohm**

Continue: I01/1

TIGHTENING TORQUES

Attachment of end plate of commutator end shield:	1,5...2,0 Nm
Attachment of commutator end shield and drive-end bearing:	5,5...6,0 Nm
Solenoid-switch attachment:	4,5...6,0 Nm
Brush-holder connection, term. 45:	7...9 Nm
Connection, term. 30:	7...9 Nm

Continue: I01/1

LUBRICANTS/LUBRICATION SCHEDULE

General:

Commutator and carbon brushes are to be kept free of grease and oil.

Greased parts are to be degreased before re-lubricating them.

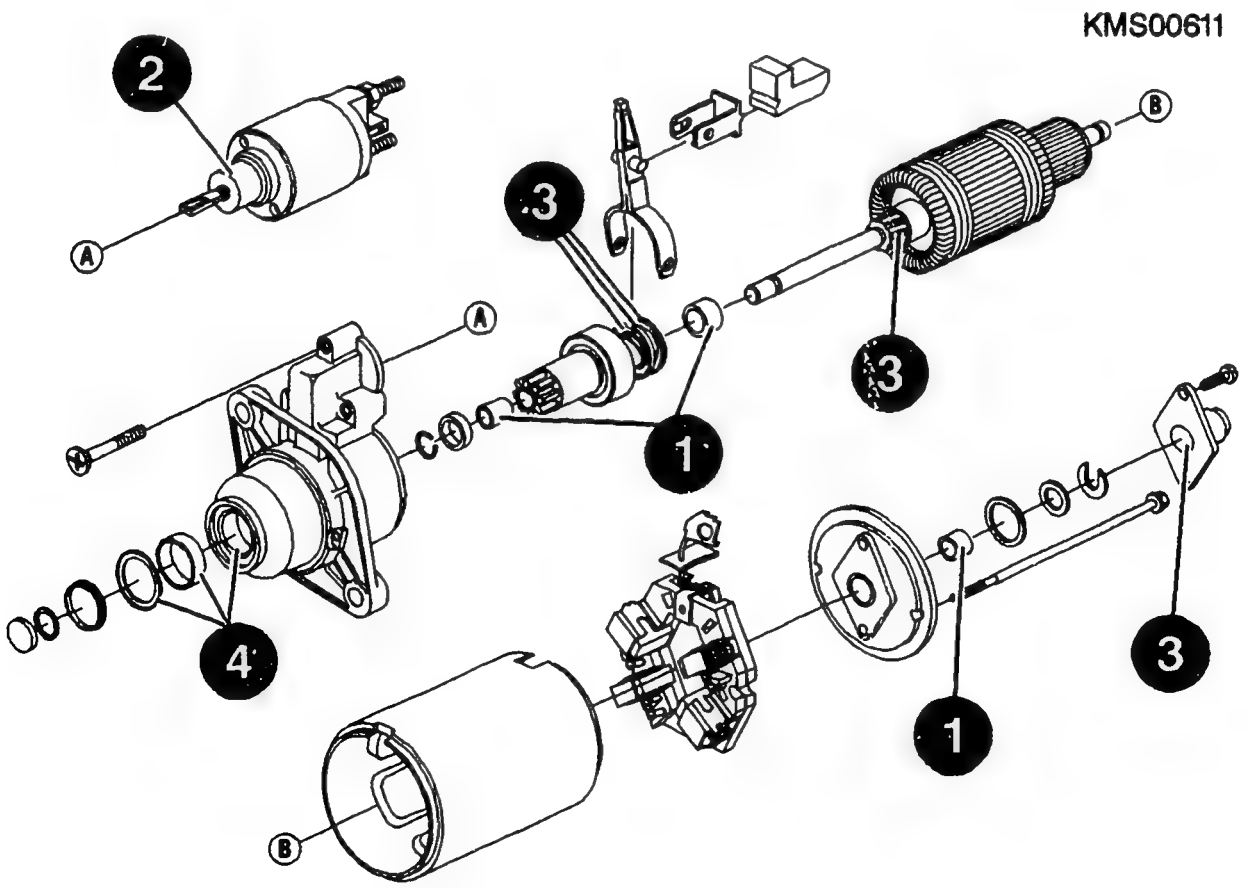
New bushings must be moistened prior to installation using suitable oil.
Oil VS 13 834-01: 5 962 260 000

Continue: I19/1

LUBRICANTS/LUBRICATION SCHEDULE

1	=	Oil VS 13834-Öl	5 962 260 000
2	=	Grease VS 16634-Ft	5 990 260 000
3	=	Grease VS 18036-Ft	5 997 098 000
4	=	Grease VS 18099-Ft	5 997 287 000

Continue: I01/1 Fig.: I19/2

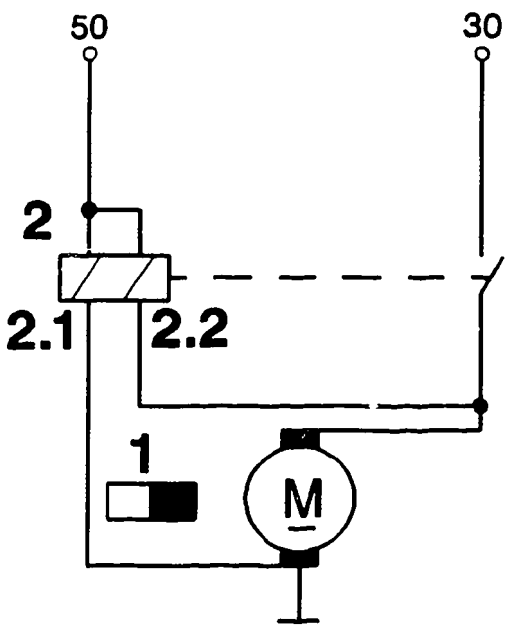


CIRCUIT DIAGRAM

1 = Exciter field
(permanent magnet)
2 = Solenoid switch
2.1 = Holding winding
2.2 = Pull-in winding

Continue: I01/1 Fig.: I20/2

KMS00394



STARTING MOTOR DISASSEMBLY TABLE

Continue: I01/1

STARTING-MOTOR DISASSEMBLY

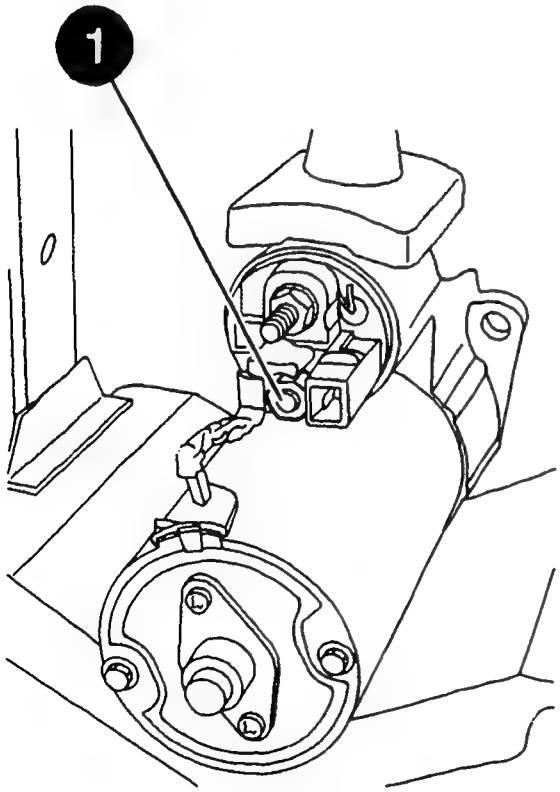
Solenoid-switch disassembly

Clamp starting motor in clamping support. Unfasten connection (1) of excitation winding at solenoid switch.

Clamping support: 0 986 619 362

Continue: I23/1 Fig.: I22/2

KMS00395



STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Mark position of solenoid switch.
Unfasten solenoid switch bolts.

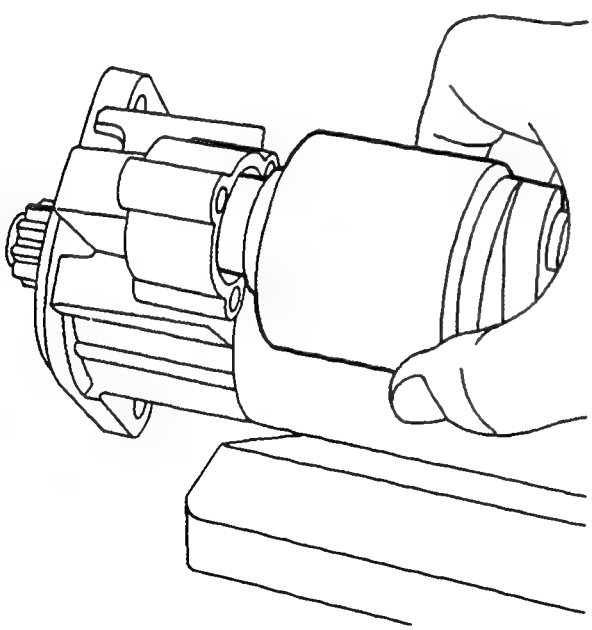
DANGER OF ACCIDENT

The pretensioned return spring causes the solenoid switch to be pressed down by the switch armature.

Pull solenoid switch off switch armature. Pay attention to return spring in solenoid switch armature.

Continue: I24/1 Fig.: I23/2

KMS00396



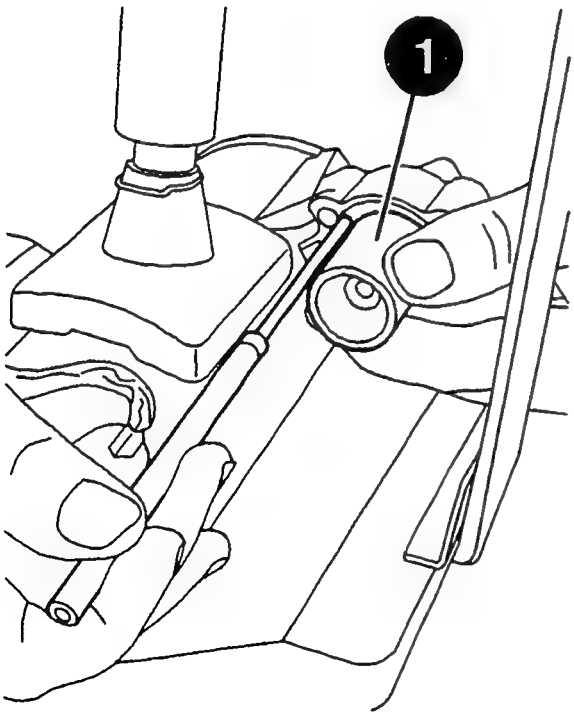
STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Use suitable tool to pull back engaging lever and disengage solenoid switch armature (1) at engaging lever.

Continue: I21/1 Fig.: I24/2

KMS00397



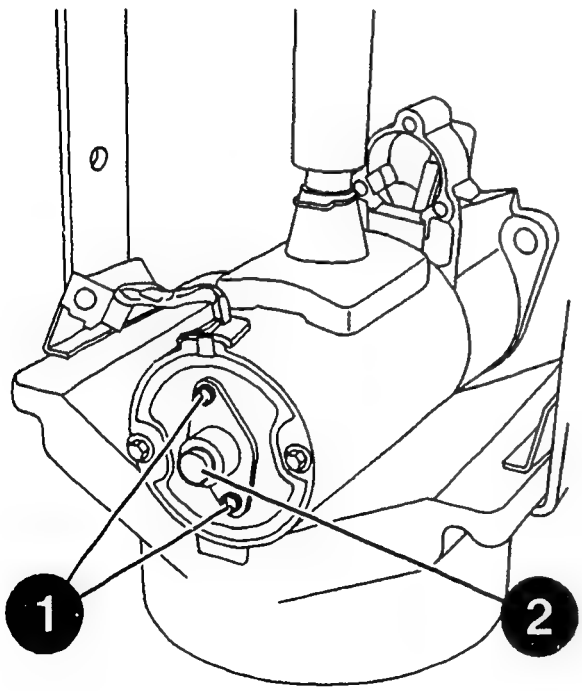
STARTING MOTOR DISASSEMBLY

Disassembling bearing-end plate

Unfasten bolts (1) of bearing-end plate (2). Remove bearing-end plate with sealing ring.

Continue: I21/1 Fig.: I25/2

KMS00398



STARTING MOTOR DISASSEMBLY

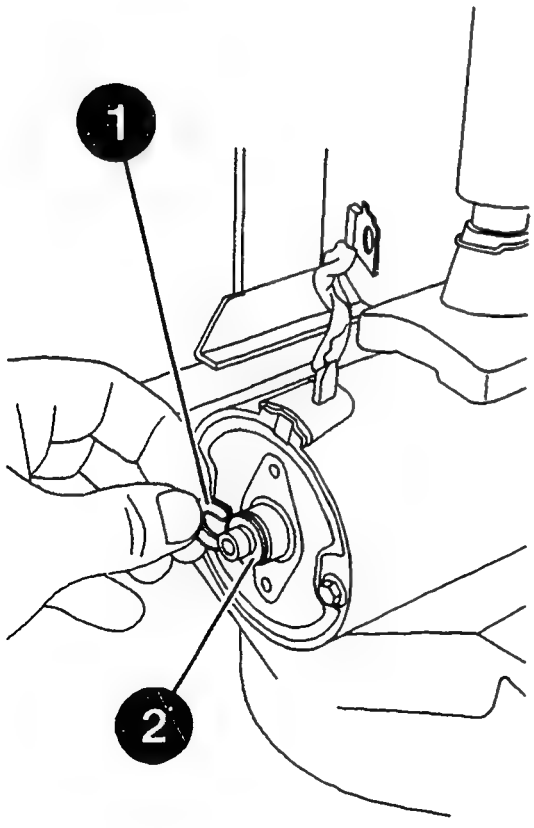
Disassembling commutator end shield

Remove positioning washer (1) of armature shaft and shim (2).

NOTE: If there is any burr at the armature shaft groove, start by removing this burr with an oilstone or the like.

Continue: I27/1 Fig.: I26/2

KMS00399



STARTING MOTOR DISASSEMBLY

Disassembling commutator end shield

Unfasten bolts (1).

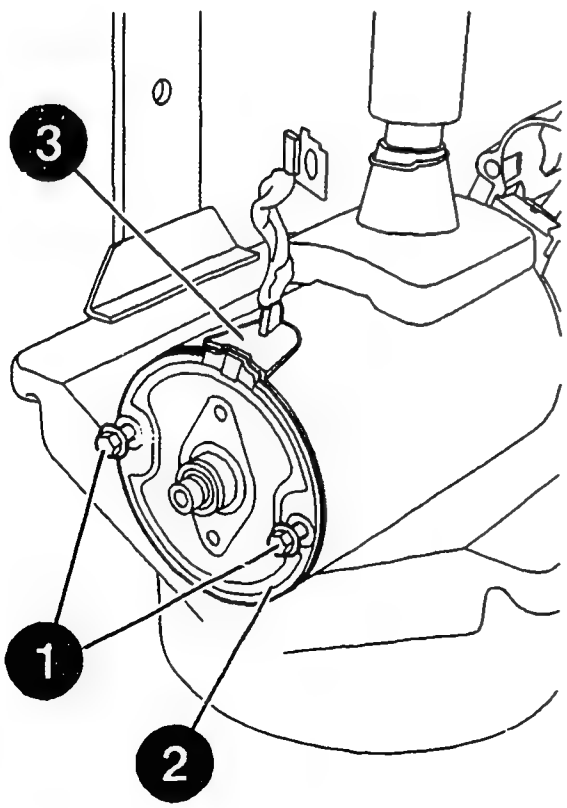
Remove commutator end shield (2) from stator frame, taking care not to damage gasket (3).

DANGER OF INJURY

The drive-end bearing is not fixed in position with respect to the stator frame.

Continue: I21/1 Fig.: I27/2

KMS00400



STARTING MOTOR DISASSEMBLY

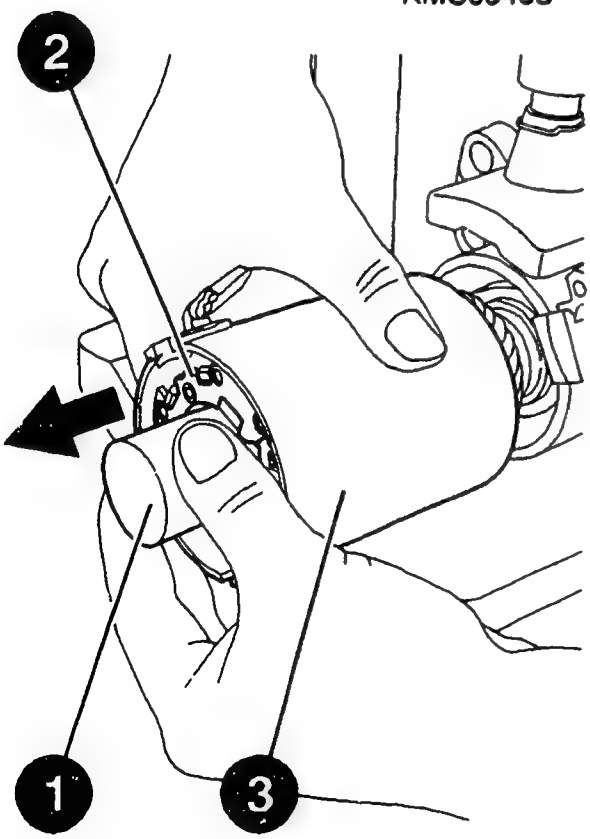
Disassembling stator frame and brush holder

Attach locating sleeve (1) to armature shaft from commutator end and pull stator frame (3) (with brush holder) off armature shaft in direction of arrow. This pushes the brush holder (2) onto the locating sleeve.
NOTE: Carbon brushes must make full contact with locating sleeve.

Brush holder
locating sleeve: to be improvised

Continue: I21/1 Fig.: I28/2

KMS00458



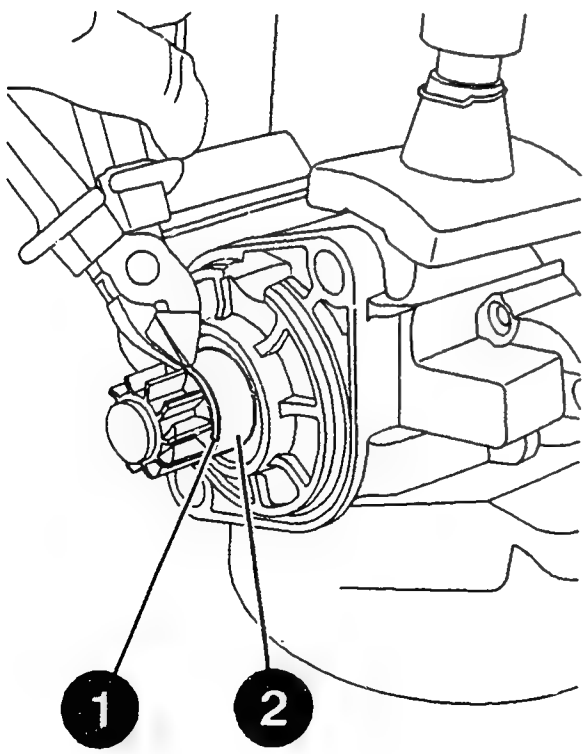
STARTING MOTOR DISASSEMBLY

Disassembling drive-end bearing

Pull pinion out of drive-end bearing as far as it will go.
Cut through thrust ring (1) with suitable tool (e.g. side-cutting pliers) and then remove ring.
Take care not to damage bearing surface (2).
DANGER OF INJURY

Continue: II02/1 Fig.: II01/2

KMS00405



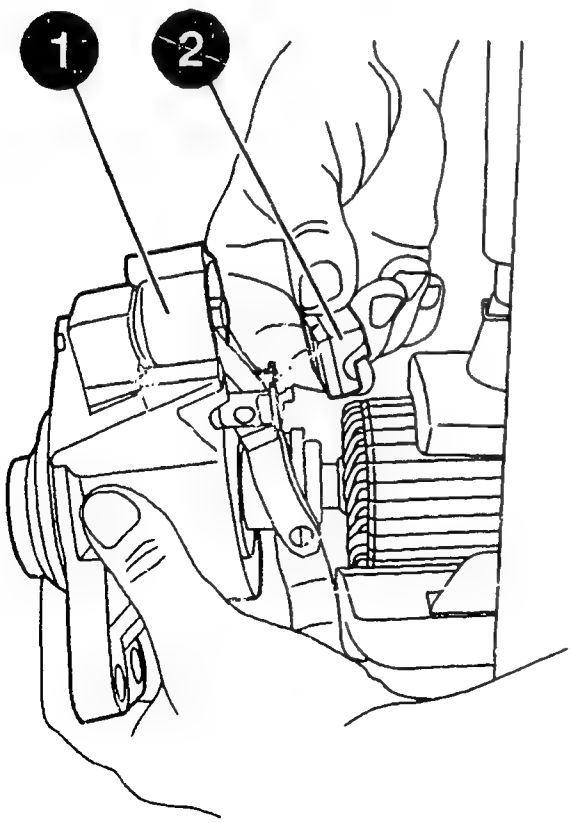
STARTING MOTOR DISASSEMBLY

Disassembling drive-end bearing

Clamp assembly at armature in clamping support.
Pull off drive-end bearing (1); in doing so remove rubber seal (2).

Continue: I21/1 Fig.: II02/2

KMS00459



STARTING MOTOR DISASSEMBLY

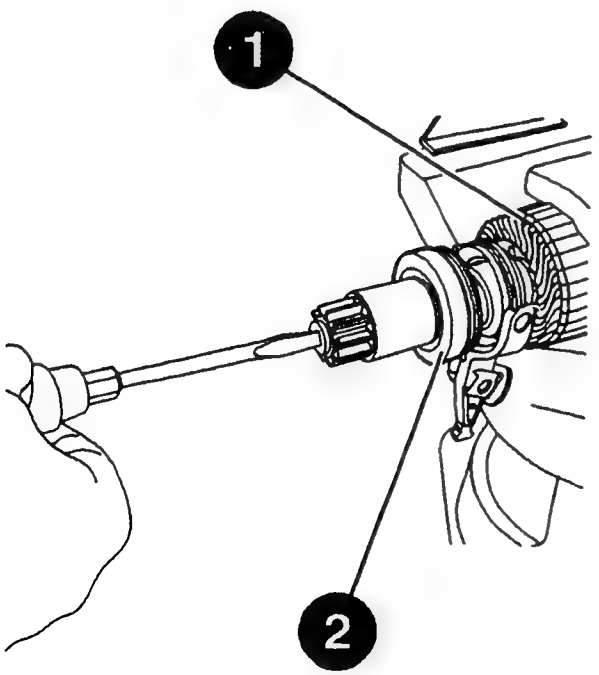
Disassembling cap

Check tightness of armature (1) complete with overrunning-clutch drive (2) in clamping support. Use plastic-headed hammer to gently tap suitable tool into edge of cap (see Fig.) and prise off cap. DANGER OF INJURY

Clamping support: 0 986 619 362

Continue: I21/1 Fig.: II03/2

KMS00461



STARTING MOTOR DISASSEMBLY

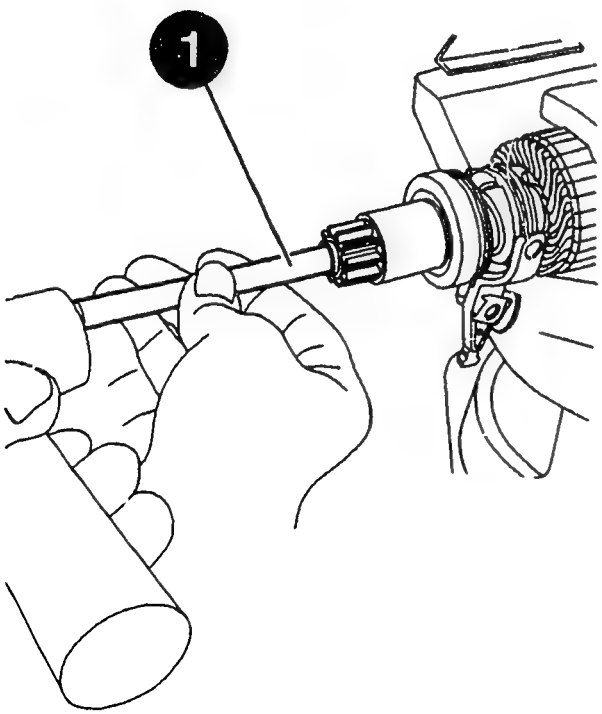
Disassembling overrunning-clutch drive

Slip disassembly sleeve (1) over output shaft and position on stop ring.
Knock back stop ring by tapping firmly (plastic-headed hammer) on disassembly sleeve.

Disassembly sleeve: 0 986 619 418

Continue: II05/1 Fig.: II04/2

KMS00462



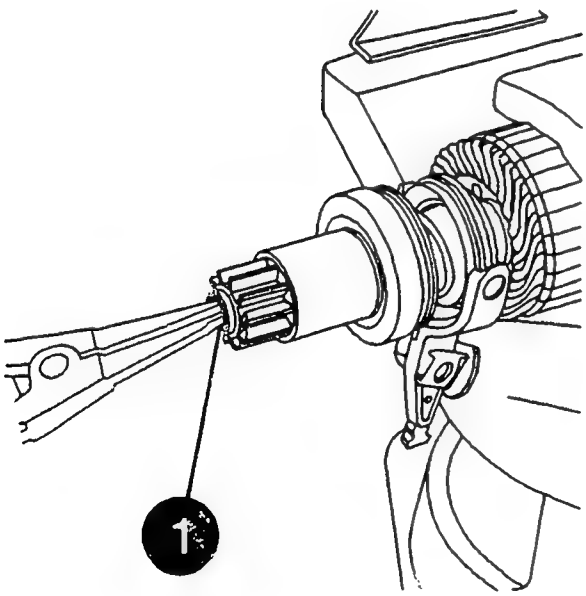
STARTING MOTOR DISASSEMBLY

Disassembling overrunning-clutch drive

Use suitable tool to remove snap ring (1) from output shaft.
Take care not to damage output shaft.
DANGER OF INJURY
The pretension may cause the snap ring to spring off the output shaft.

Continue: II06/1 Fig.: II05/2

KMS00463



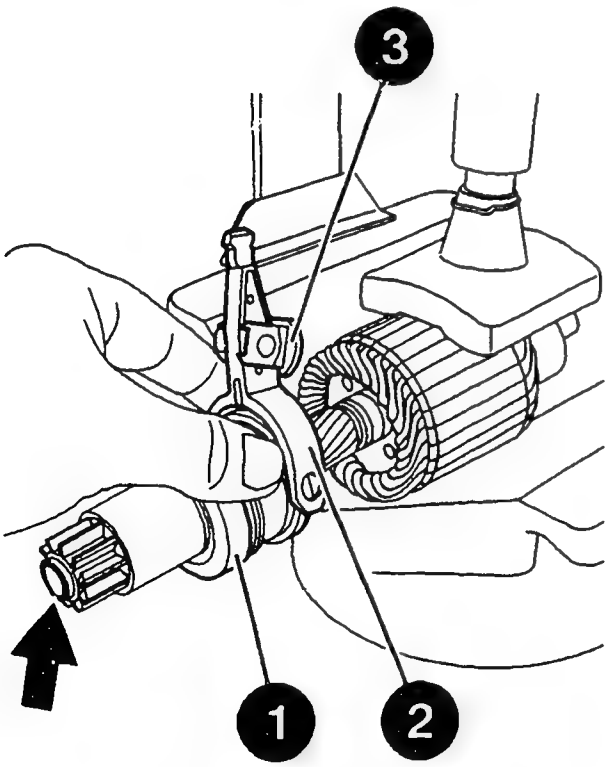
STARTING MOTOR DISASSEMBLY

Disassembling overrunning-clutch drive

Remove overrunning-clutch drive (1) with engaging lever (2) and mount (3) from output shaft.
Pay attention to stop ring in pinion hole (see arrow).

Continue: I21/1 Fig.: II06/2

KMS00464



COMPONENT CLEANING

Component cleaning:
Armature, commutator end shield, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Use is never to be made of liquid cleaning agents.

Other parts such as stator frame and drive-end bearing can be washed out with commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours. Components must be re-lubricated or re-greased in line with lubrication schedule.

Continue: II07/2

COMPONENT CLEANING

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Continue: II08/1

COMPONENT CLEANING

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: II08/2

COMPONENT CLEANING

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTING, REPAIR TABLE

Continue: I01/1

COMPONENT TESTING AND REPAIR

Testing pinion

Meshing pinion and overruning-clutch drive are subject to considerable wear. Overruning-clutch drive is therefore always to be replaced.

Continue: II09/1

COMPONENT TESTING AND REPAIR

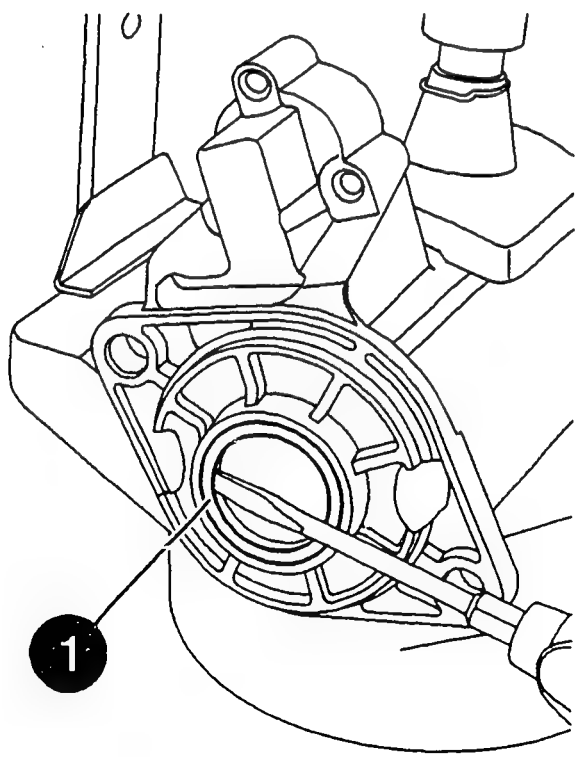
Checking drive-end bearing

Sealing ring and bushing of drive-end bearing must always be replaced.

Sealing ring removal:
Use suitable tool to prise out sealing ring (1).

Continue: II12/1 Fig.: II11/2

KMS00411



COMPONENT TESTING AND REPAIR

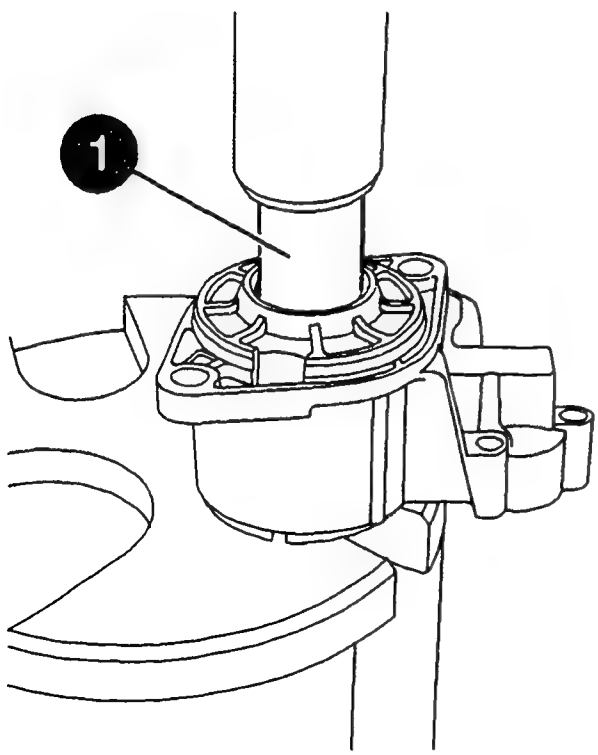
Checking drive-end bearing

Bushing removal:
Use pressing-out mandrel (1) to press out bushing inwards.

Mandrel press: comm. avail.
Pressing-out mandrel: to be improvised

Continue: II13/1 Fig.: II12/2

KMS00412



COMPONENT TESTING AND REPAIR

Checking drive-end bearing

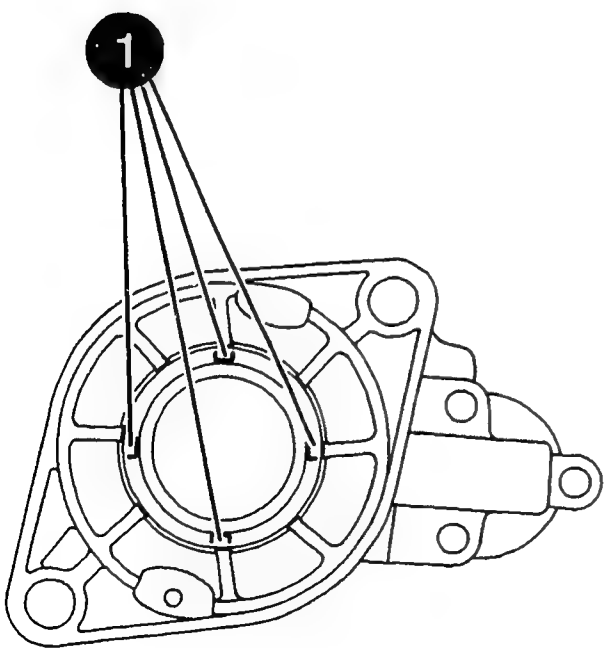
After removing sealing ring and bushing, use three-square scraper to carefully clean off projecting caulking (1) material.

ATTENTION: Take care not to damage fitting surfaces of bearing and sealing ring seat.

Three-square scraper: comm. avail.

Continue: II14/1 Fig.: II13/2

KMS00413



Checking drive-end bearing

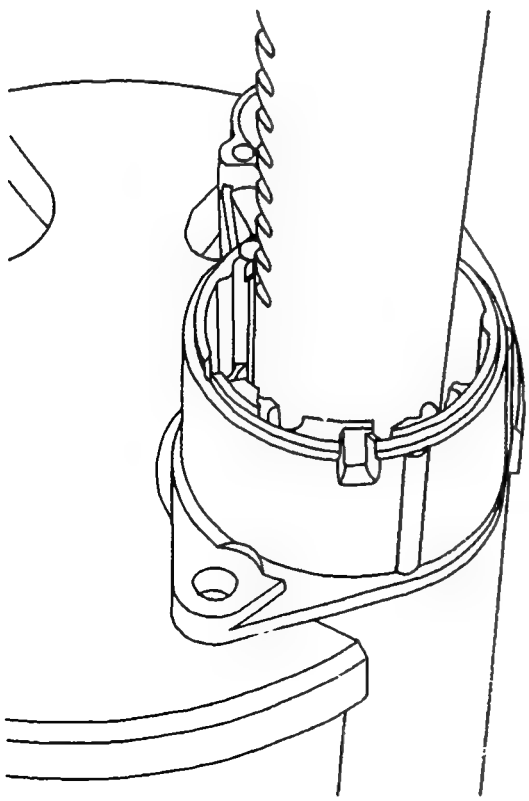
Bushing installation:
Make direct use of mandrel of mandrel press to carefully press bushing from inside into drive-end bearing such that it is flush.

ATTENTION: Pockets of new bushing must be completely filled with grease.

Mandrel press:	comm. avail.
Grease VS 18099 Ft:	5 997 287 000

Continue: II15/1 Fig.: II14/2

KMS00414



COMPONENT TESTING AND REPAIR

Checking drive-end bearing

Sealing ring installation:

Fill seat of sealing ring in drive-end bearing with grease.

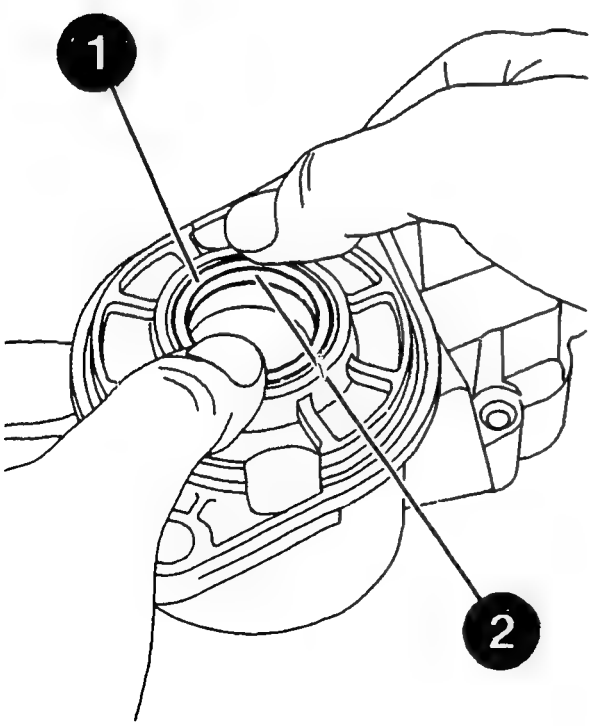
Press home sealing ring (1) by hand in drive-end bearing.

ATTENTION: Gap (2) between sealing ring and bushing must be completely filled with grease.

Grease VS 18099 Ft: 5 997 287 000

Continue: II16/1 Fig.: II15/2

KMS00415



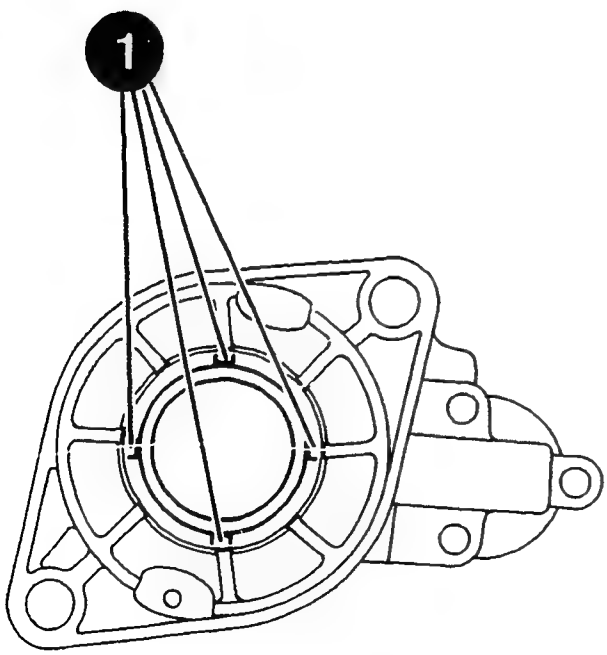
Checking drive-end bearing

Sealing ring installation (continued):
Use small cape chisel to caulk drive-end bearing at four locations (1) (mutually offset by 90) to ensure that sealing ring is firmly attached.
Take care not to damage seat of sealing ring.
Remove surplus grease after assembly.

Small cape chisel: comm. avail.

Continue: II09/1 Fig.: II16/2

KMS00416



COMPONENT TESTING AND REPAIR

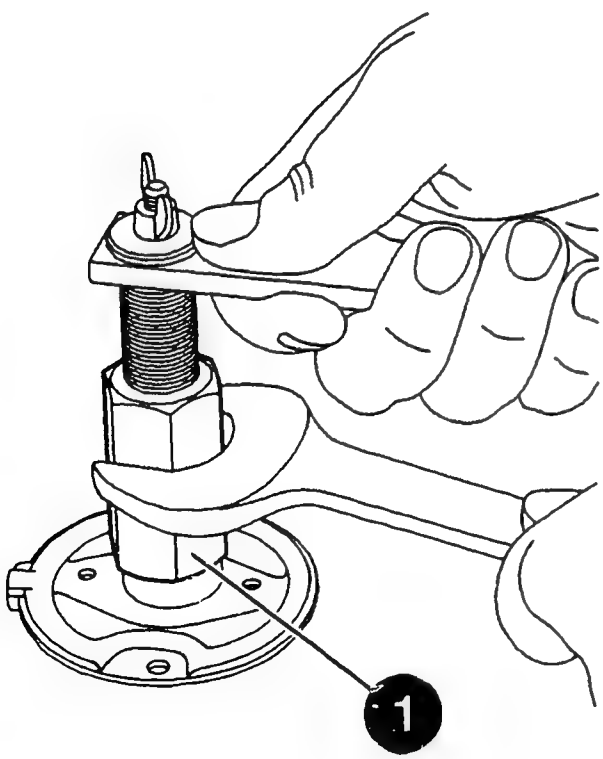
Checking commutator end shield

Check bushing for damage and scoring. Replace if necessary.
Removal: Use puller (1) and spring collet to pull bushing out of commutator end shield.

Puller:	0 986 617 243
Spring collet diameter 12.5 mm:	0 986 617 246

Continue: II18/1 Fig.: II17/2

KMS00417



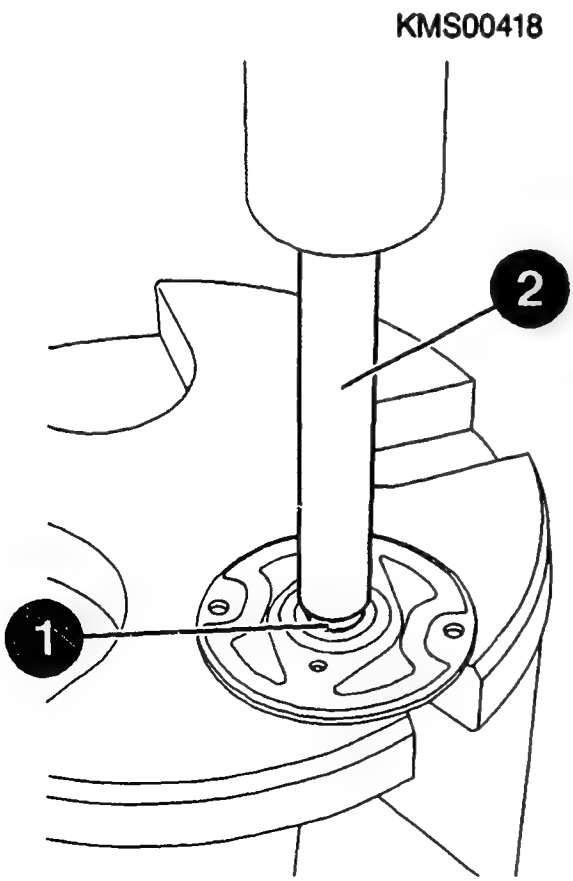
COMPONENT TESTING AND REPAIR

Checking commutator end shield

Installation: Use pressing-in mandrel (2) to press new bushing (1) from inside (see Fig.) into commutator end shield such that it ends 0.2...0.4 mm before outer collar of commutator end shield.
If necessary, use old bushing to press in to required dimension.
ATTENTION: New bushing must be moistened beforehand with suitable oil.

	comm. avail.
Mandrel press:	
Pressing-in mandrel:	0 986 617 212
Oil VS 13 834-Ö1:	5 962 260 000

Continue: II09/1 Fig.: II18/2



COMPONENT TESTING AND REPAIR

Checking overrunning-clutch drive

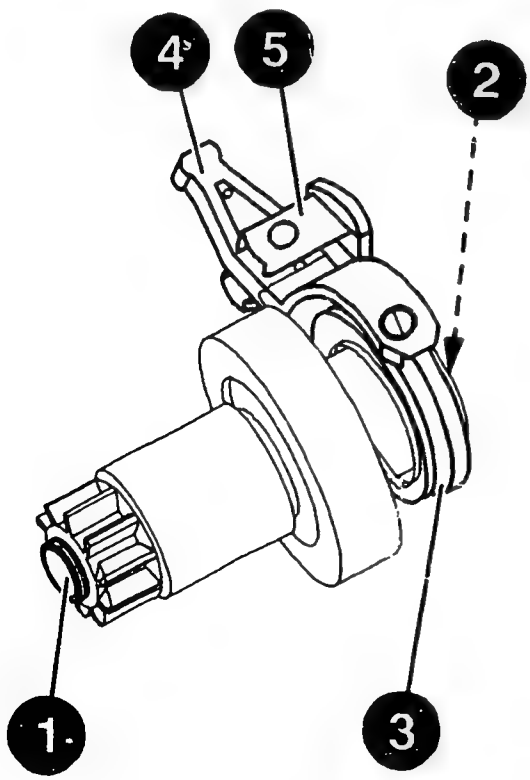
Pinion, bushings (1), spiral spline (2) and driver edges (3) of overrunning-clutch drive are subject to a high degree of wear.

The overrunning-clutch drive is thus always to be replaced.

Also replace engaging lever (4) and its mount (5).

Continue: II20/1 Fig.: II19/2

KMS00482



COMPONENT TESTING AND REPAIR

Checking overrunning-clutch drive

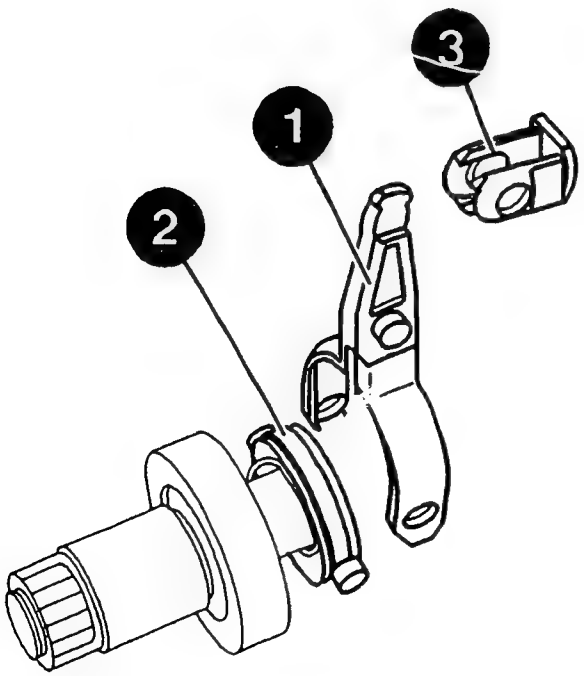
Engage new engaging lever (1) at driver (2) on overrunning-clutch drive.

Engage new mount (3) at engaging lever with open end facing pinion.

NOTE: Fig. shows disassembled engaging lever and mount.

Continue: II09/1 Fig.: II20/2

KMS00481



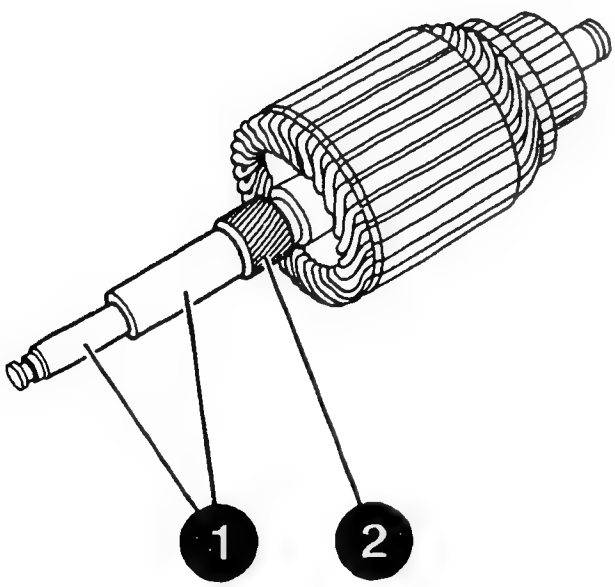
COMPONENT TESTING AND REPAIR

Checking armature

The entire armature is to be replaced if one of the bearing surfaces (1) on the output shaft or the spiral spline (2) is worn or damaged.

Continue: II22/1 Fig.: II21/2

KMS00465



COMPONENT TESTING AND REPAIR

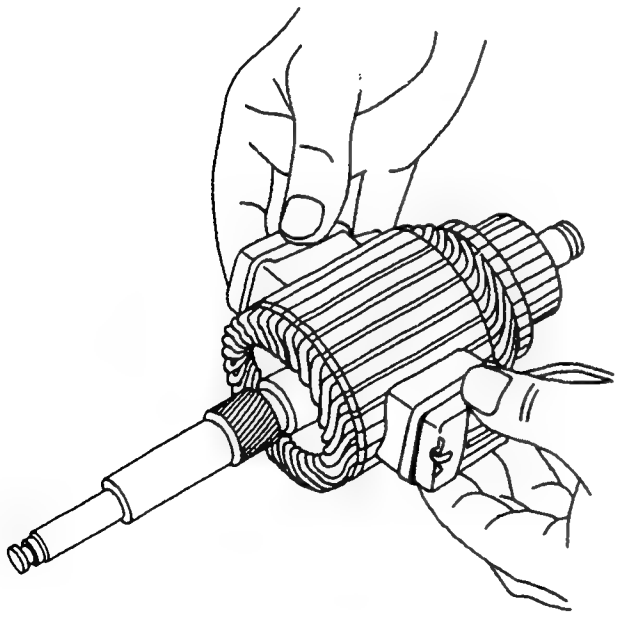
Testing armature

Check armature for interturn short circuit using tester and test probes.

Interturn short-circuit tester with test probes: 0 986 619 110

Continue: II23/1 Fig.: II22/2

KMS00484



COMPONENT TESTING AND REPAIR

Checking armature

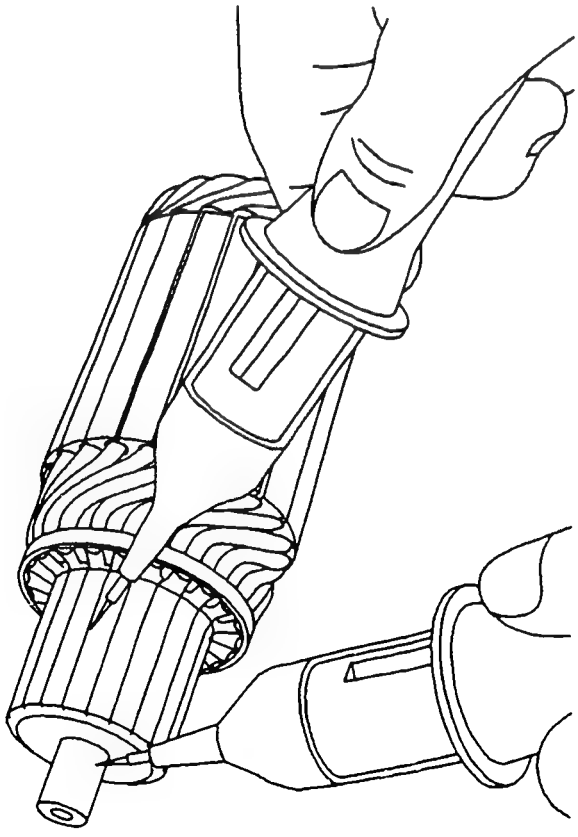
Use tester and test prods to check armature for short to ground and continuity (black laminations are an indication of an open circuit).

Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101
Test voltage for checking short to ground:	40 V*
Continuity test voltage:	40 V*

* = AC

Continue: II09/1 Fig.: II23/2

KMS00229



Testing commutator

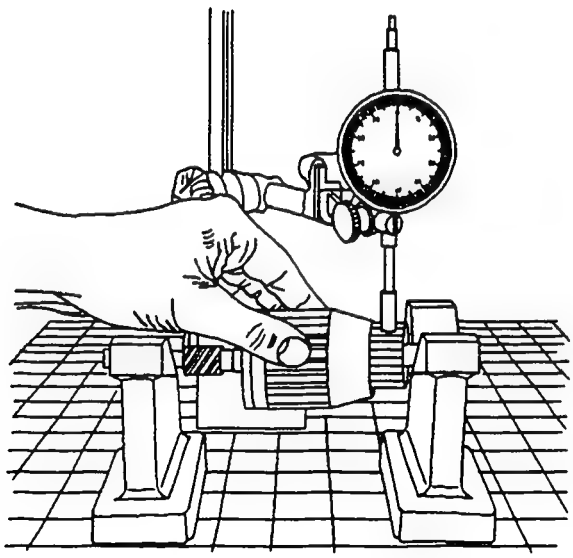
Check commutator concentricity.
If radial run-out is outside stated range, commutator must be turned down.

Magnetic measurement stand:	4 851 601 124
Dial indicator:	1 687 233 011

Radial run-out - Commutator:	< 0,02 mm

Continue: II25/1 Fig.: II24/2

KMS00192



COMPONENT TESTING AND REPAIR

Testing commutator

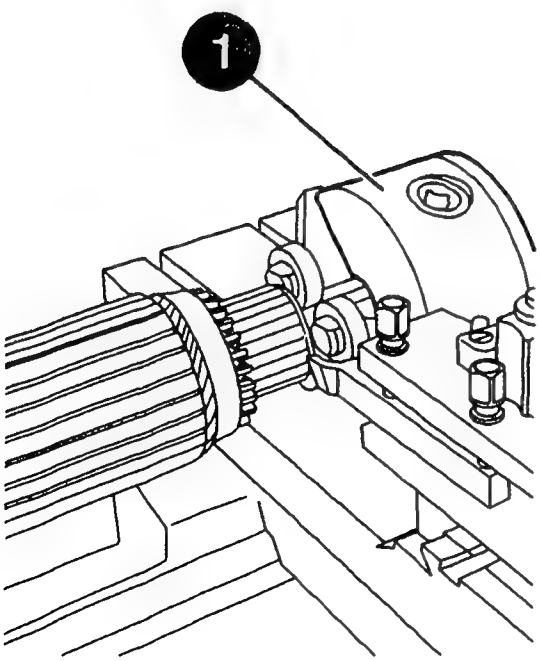
Turning down involves positioning armature in three-jaw chuck and tailstock rest (1). The max. machining thickness is 0.03 mm.
Pay attention to minimum diameter.

Tailstock rest with
Morse taper 2: 0 986 619 156

Mininum diameter: 33,5 mm

Continue: II26/1 Fig.: II25/2

KMS00193



COMPONENT TESTING AND REPAIR

Checking commutator

After turning down, the commutator segment insulation must be sawn out to a depth of 0.8 mm with a suitable tool.

After sawing out, turn down commutator again and check armature for interturn short circuit and short to ground. Pay attention to diameter.

The carbon-brush wear dimension is also to be checked with turned-down armature.

Continue: II26/2

COMPONENT TESTING AND REPAIR

The brush holder is to be replaced if necessary.

Interturn-short-circuit tester:	0 986 619 110
Minimum diameter:	33,5 mm
Test voltage when checking for short to ground:	40 V*

* = AC

Continue: II09/1

COMPONENT TESTING AND REPAIR

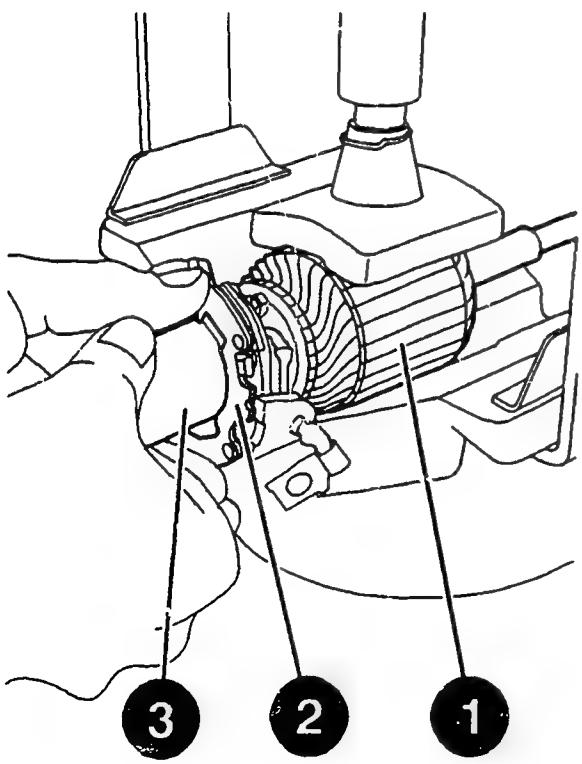
Checking carbon-brush wear

Wear dimension is to be checked with armature fitted.
Clamp armature (1) in clamping support.
Pull brush holder (2) with locating sleeve (3) out of stator frame and slip onto armature shaft.
Push brush holder (2) from locating sleeve (3) onto commutator and remove locating sleeve (3).

Clamping support: 0 986 619 362

Continue: II28/1 Fig.: II27/2

KMS00466



COMPONENT TESTING AND REPAIR

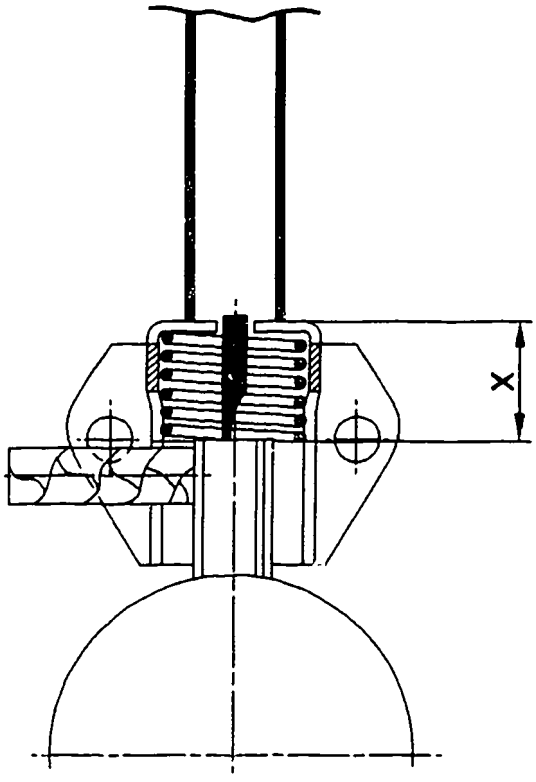
Checking carbon brush wear

The carbon-brush wear dimension x is measured with a depth gauge from the top edge of the cartridge-type brush holder to the top edge of the carbon brush.

Carbon-brush wear dimension x:	< 14 mm

Continue: III01/1 Fig.: II28/2

KMS00393



COMPONENT TESTING AND REPAIR

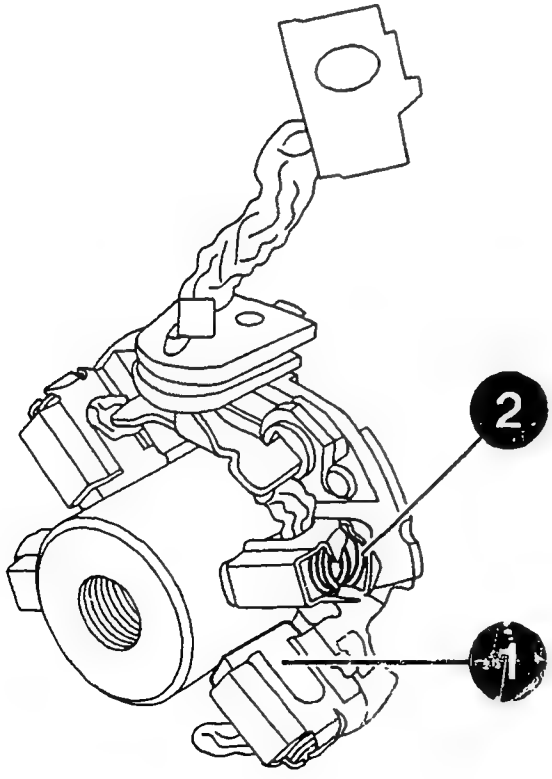
Checking carbon brush wear

The entire brush holder must be replaced if the carbon brushes (1) are worn down to the minimum length or damaged or if the helical compression springs (2) are worn.

Exclusive use is to be made of replacement parts from the list applying to the type of starting motor concerned.

Continue: II09/1 Fig.: III01/2

KMS00424



COMPONENT TESTING AND REPAIR

Checking stator frame

Check stator frame for damage.

Check permanent magnets for generating exciter field for damage and correct positioning in stator frame.

If necessary, the entire stator frame is to be replaced.

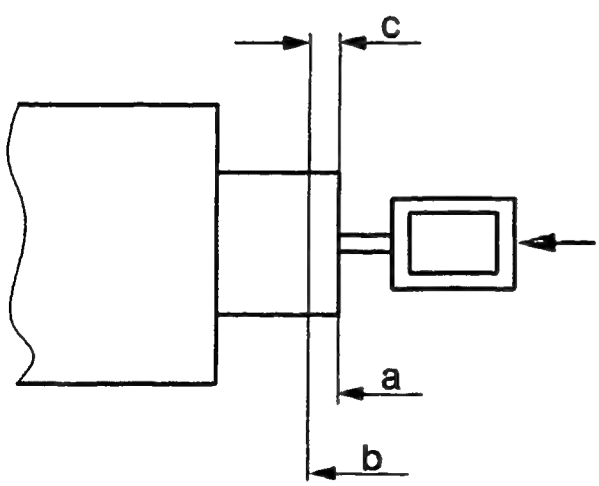
Continue: II09/1

Testing solenoid switch

Examine solenoid switch for damage.
Check burn-off reserve.
Press in armature by hand until current bridge is resting (a) on terminal stud. On pressing in the armature further as far as stop (b) a noticeable increase in force is apparent. The difference between positions (a) and (b) is the burn-off reserve (c). If there is no further burn-off reserve, the solenoid switch must be replaced.

Continue: III04/1 Fig.: III03/2

KMS00375



COMPONENT TESTING AND REPAIR

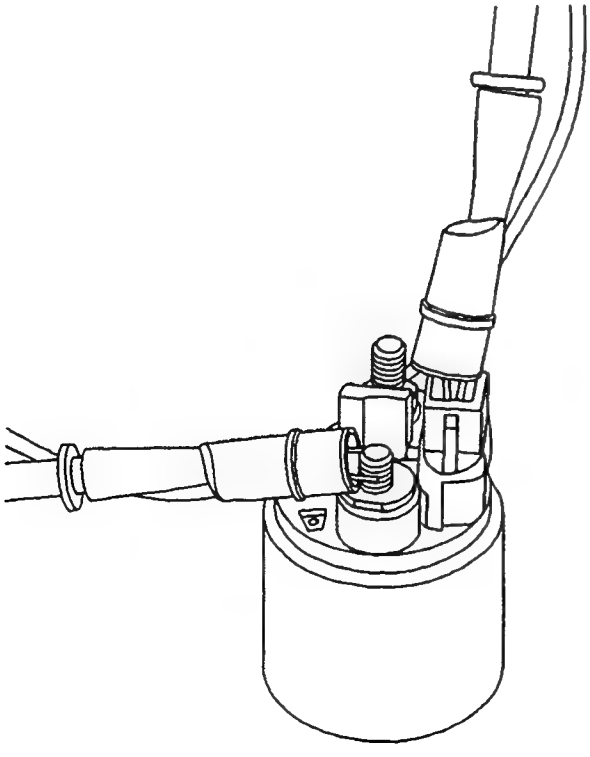
Checking solenoid switch

Use tester to check resistance of pull-in winding (term. 50/term. 45).

Alternator tester:	0 684 201 200
Pull-in winding resistance:	0,3...0,4 Ohm

Continue: III05/1 Fig.: III04/2

KMS00426

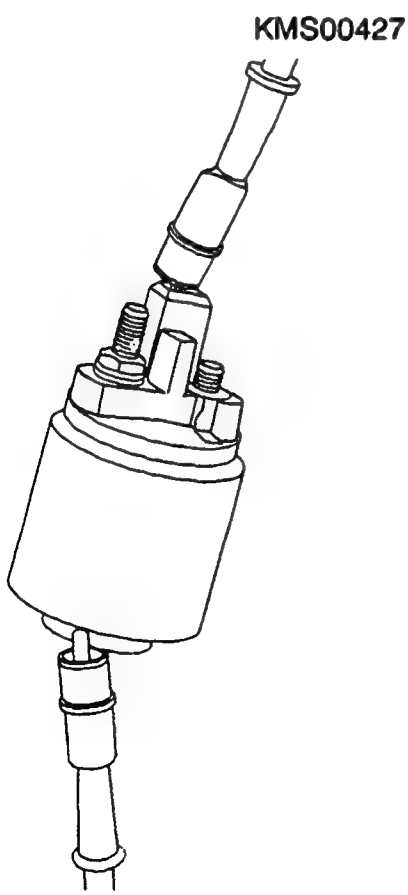


Checking solenoid switch

Use tester to check resistance of holding winding (term. 50/ground).

Alternator tester:	0 684 201 200
Holding-winding resistance:	1,5...1,7 Ohm

Continue: III06/1 Fig.: III05/2



COMPONENT TESTING AND REPAIR

Testing solenoid switch

Neither the tests described, nor proper functioning of the solenoid switch when testing the function of the starting motor following repairs can provide reliable information on long-term trouble-free operation of the solenoid switch.
It is therefore advisable to renew the solenoid switch when the starting motor is repaired.

Continue: II09/1

STARTING MOTOR ASSEMBLY TABLE

Continue: III07/2

STARTING MOTOR ASSEMBLY TABLE

Continue: I01/1

STARTING MOTOR ASSEMBLY

Assembling overrunning-clutch drive

Lubricate in line with lubrication schedule before and during starting-motor assembly. Clamp armature in clamping support.

Clamping support: 0 986 619 362

Continue: III09/1

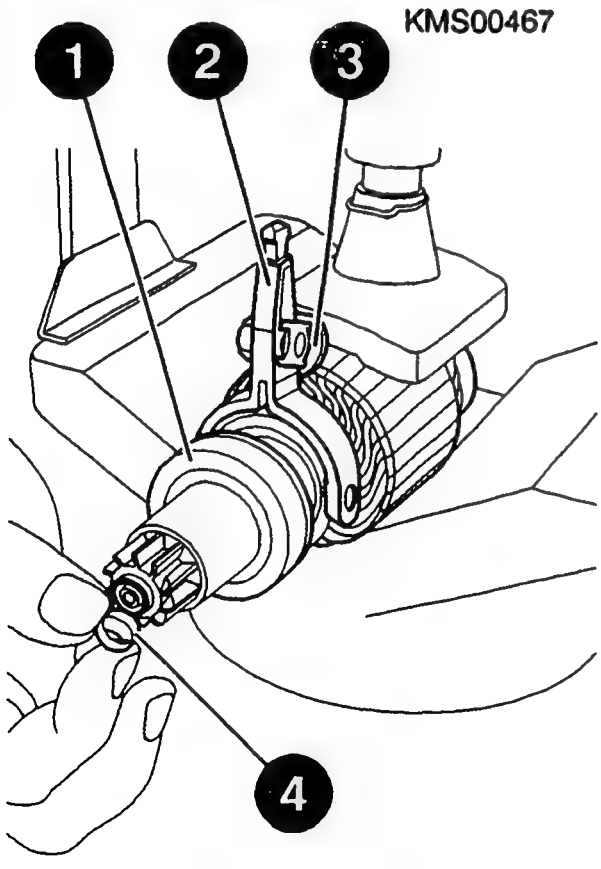
STARTING MOTOR ASSEMBLY

Assembling overrunning-clutch drive

Slip overrunning-clutch drive (1) with engaging lever (2) and mount (3), as well as new stop ring (4) onto output shaft of armature.
ATTENTION: Spiral spline of drive must be dry and free from grease to stop output shaft becoming pasty. Only grease spiral spline on output shaft.

Grease VS 18036 Ft: 5 997 098 000

Continue: III10/1 Fig.: III09/2



STARTING MOTOR ASSEMBLY

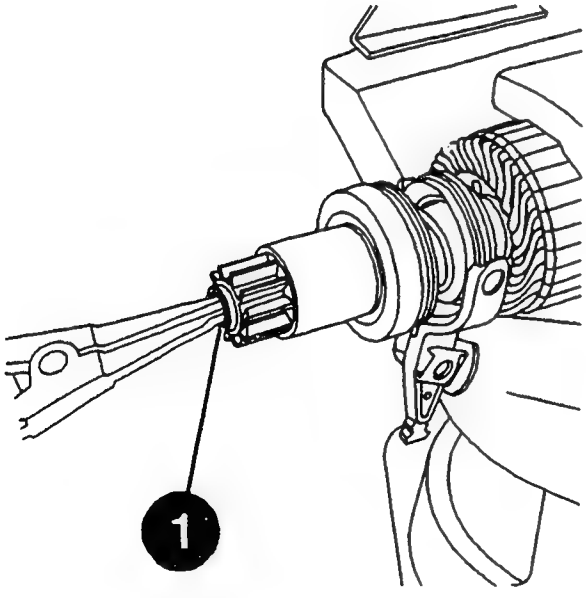
Assembling overrunning-clutch drive

Insert new snap ring (1) in annular groove.

ATTENTION: Take care not to damage output shaft.

Continue: III11/1 Fig.: III10/2

KMS00463



STARTING MOTOR ASSEMBLY

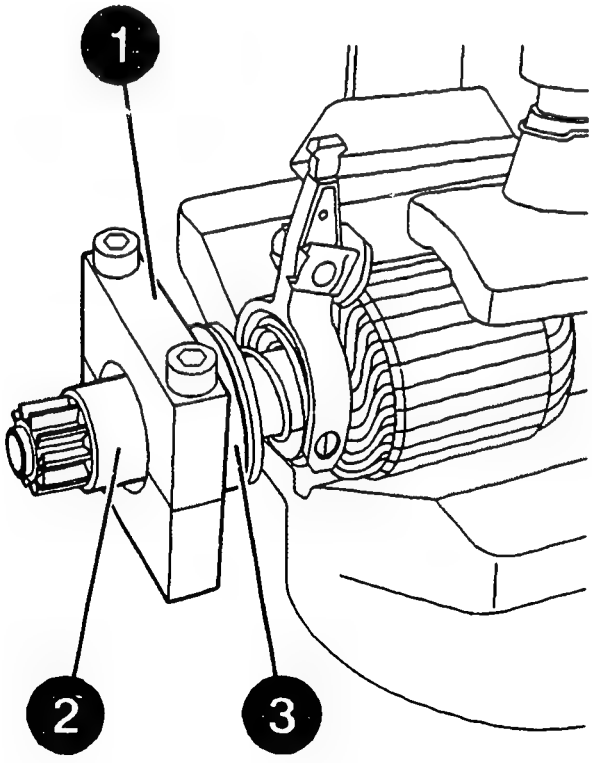
Assembling overrunning-clutch drive

Attach holding fixture (1) to pinion body (2) such that it rests on overrunning clutch (3).
Use torque wrench.
ATTENTION: Take care not to damage surface of body.

Holding fixture:	0 986 619 420
Torque wrench:	comm. avail.
Tightening torque:	25 Nm

Continue: III12/1 Fig.: III11/2

KMS00469



STARTING MOTOR ASSEMBLY

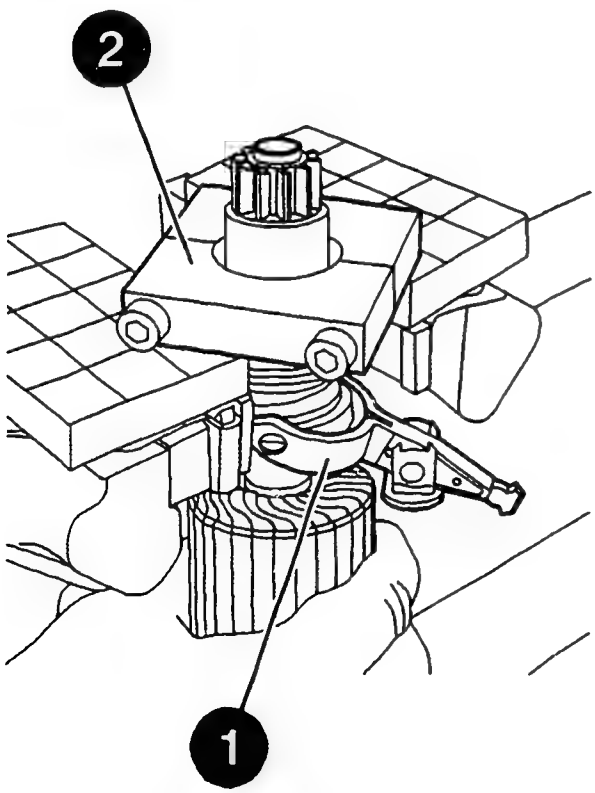
Assembling overrunning-clutch drive

Remove assembly (1) from assembly stand and position with holding fixture (2) on vice.

ATTENTION: Assembly must not make contact with the vice and must be freely accessible from underneath.

Continue: III13/1 Fig.: III12/2

KMS00470



STARTING MOTOR ASSEMBLY

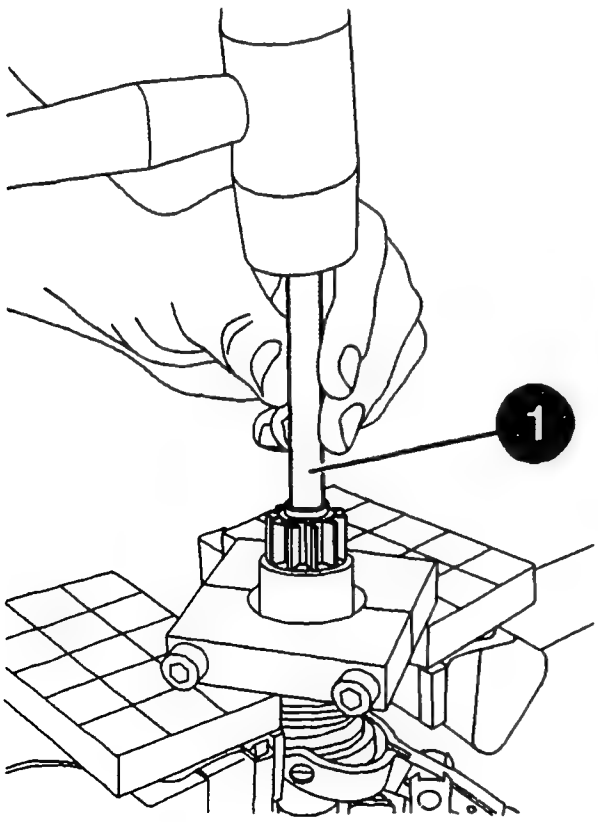
Assembling overrunning-clutch drive

Mount tapered end of assembly sleeve (1) on output shaft.
Tap firmly (plastic-headed hammer) on assembly sleeve to engage snap ring under stop ring. Remove assembly sleeve.

Assembly sleeve:	0 986 619 417
Clamping support:	0 986 619 362

Continue: III07/1 Fig.: III13/2

KMS00471



STARTING MOTOR ASSEMBLY

Assembling armature

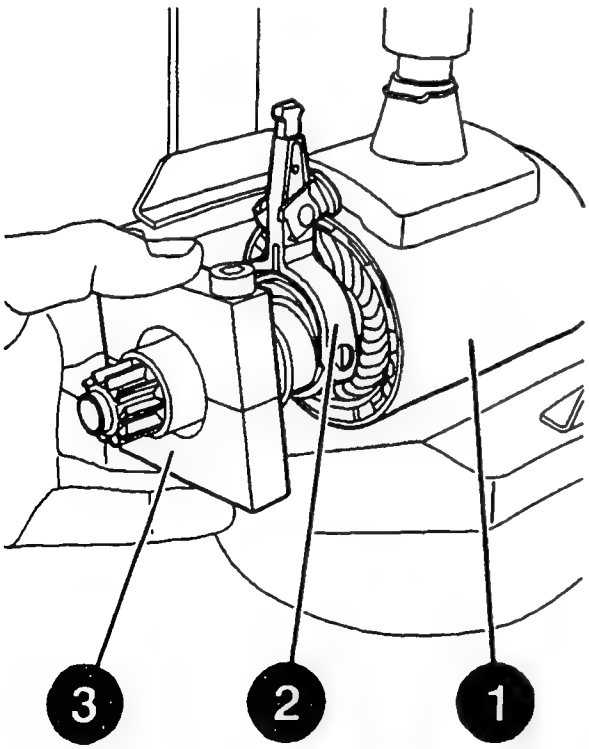
Clamp stator frame (1) in clamping support. Insert assembly (2) in stator frame from drive-end bearing side and remove holding fixture (3).

NOTE: The exciter magnetic field causes the armature to be attracted by the stator frame and held in the correct position.

Clamping support: 0 986 619 362

Continue: III07/1 Fig.: III14/2

KMS00472



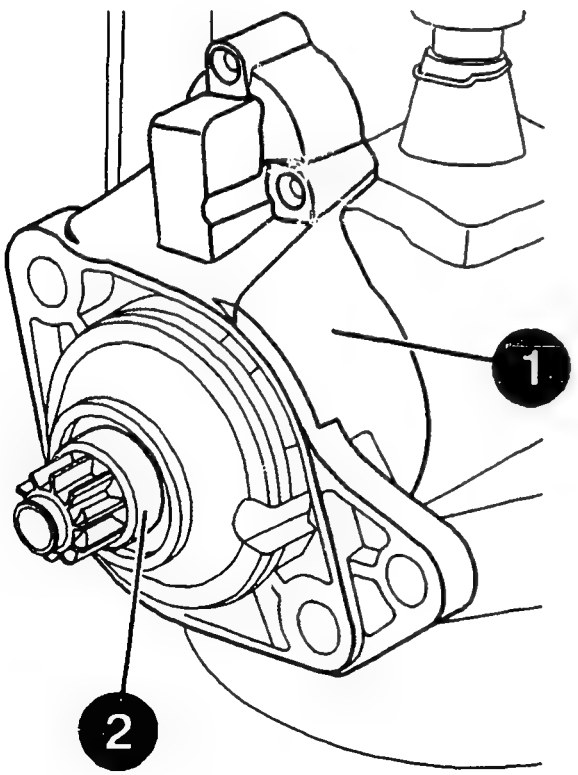
STARTING MOTOR ASSEMBLY

Assembling drive-end bearing

Use three-square scraper to clean fitting surfaces at drive-end bearing.
Slip drive-end bearing (1) onto pinion body (2). Insert rubber seal in recess. Ensure correct positioning of over-running clutch drive and mount of engaging lever in drive-end bearing.

Continue: III07/1 Fig.: III15/2

KMS00473



STARTING MOTOR ASSEMBLY

Assembling thrust ring

NOTE ON PRESSING ON THRUST RING:

Slowly increase pressure whilst pressing on and check firmness of thrust ring several times.
Only exert pressure required to ensure firm attachment of thrust ring.
Excessive pressure could result in components being destroyed.

Continue: III17/1

STARTING MOTOR ASSEMBLY

Assembling thrust ring

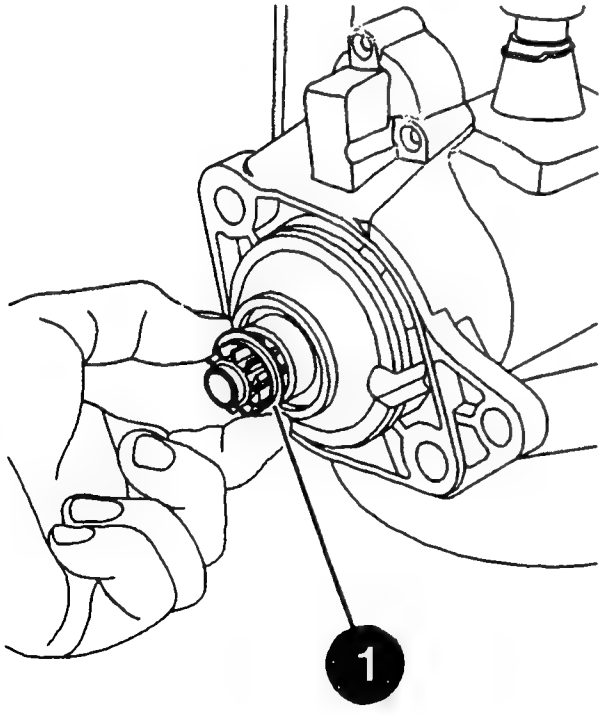
Slip thrust ring (1) with contact surface facing drive-end bearing over pinion as far as collar.

DANGER OF INJURY
Thrust ring has sharp edges.
Use pressing-on tool if necessary.
NOTE: Drive-end bearing, armature with overrunning-clutch drive and stator frame are not permanently connected.

Pressing-on tool: 0 986 619 403

Continue: III18/1 Fig.: III17/2

KL1S00474



STARTING MOTOR ASSEMBLY

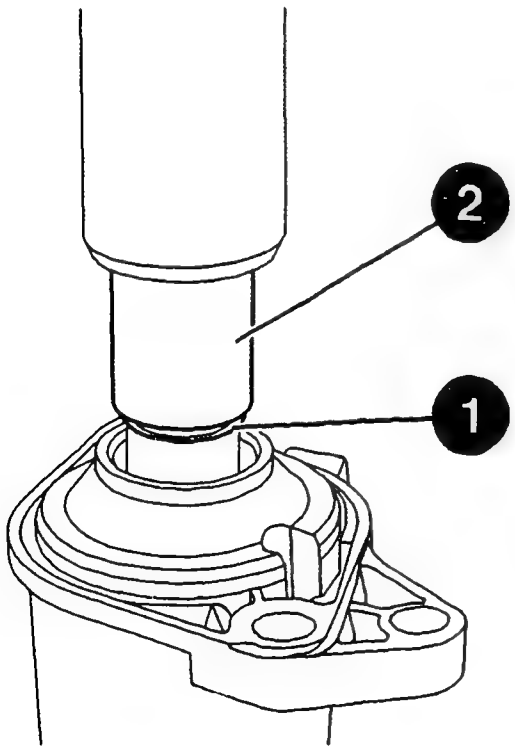
Assembling thrust ring

ATTENTION: Pay attention to notes on pressing on.
Mount pre-assembled unit on mandrel press such that armature shaft and stator frame rest on press support.
Use pressing-on tool (2) to carefully press on thrust ring (1).
Check firmness of thrust ring several times.

Pressing-on tool:	0 986 619 403
Mandrel press:	comm. avail.

Continue: III19/1 Fig.: III18/2

KMS00475



STARTING MOTOR ASSEMBLY

Assembling thrust ring

Remove assembly sleeve and check correct positioning of thrust ring again.

Leave assembly on mandrel press for fitting cap.

Continue: III07/1

STARTING MOTOR ASSEMBLY

Assembling cap

NOTE ON PRESSING ON CAP:

Slowly increase pressure whilst pressing on cap and check firmness of cap several times.

Only exert sufficient pressure to ensure firm fit of cap.

Excessive pressure could destroy components.

Continue: III20/1

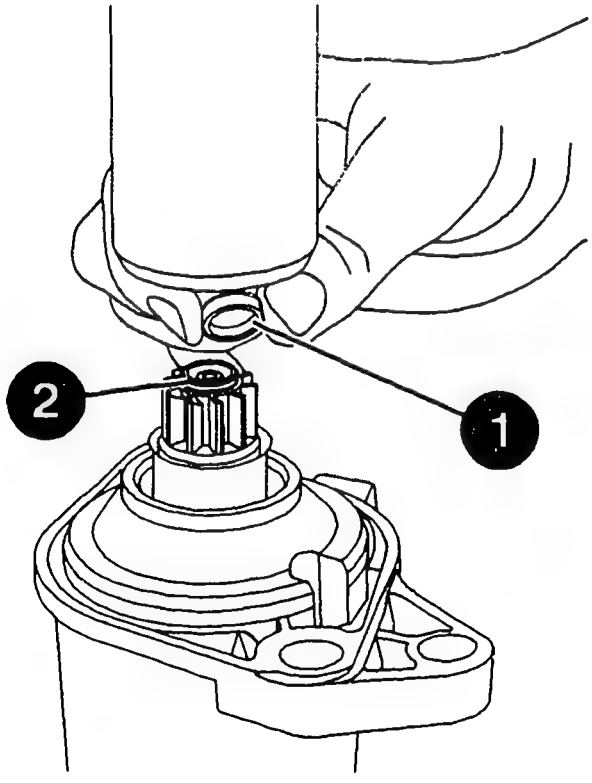
STARTING MOTOR ASSEMBLY

Assembling cap

Position cap (1) with inserted sealing ring on pinion collar (2).

Continue: III21/1 Fig.: III20/2

KMS00476



STARTING MOTOR ASSEMBLY

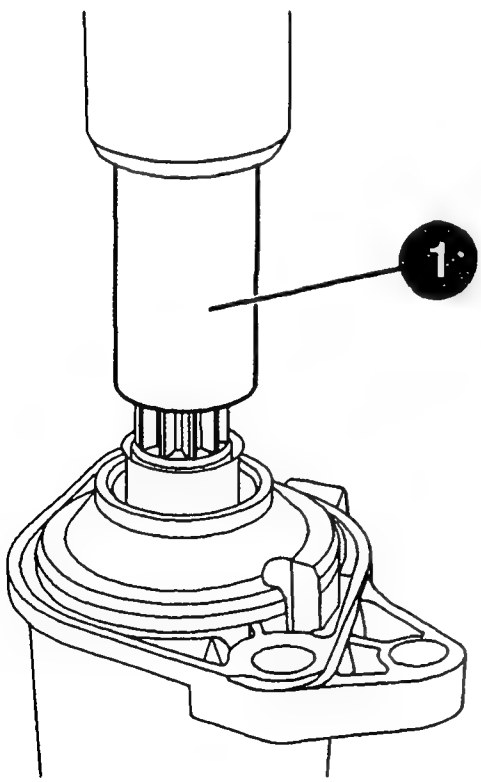
Assembling cap

ATTENTION: Always heed pressing-on instructions.
Fit collet chuck (1) and carefully press on cap using mandrel press.
Check firmness of cap several times.
Make sure collet chuck is correctly positioned. Release press, turn collet chuck through 45 and press on again.
Remove collet chuck and check correct positioning of cap.

Mandrel press:	comm. avail.
Collet chuck:	0 986 619 408/412

Continue: III07/1 Fig.: III21/2

KMS00477



STARTING MOTOR ASSEMBLY

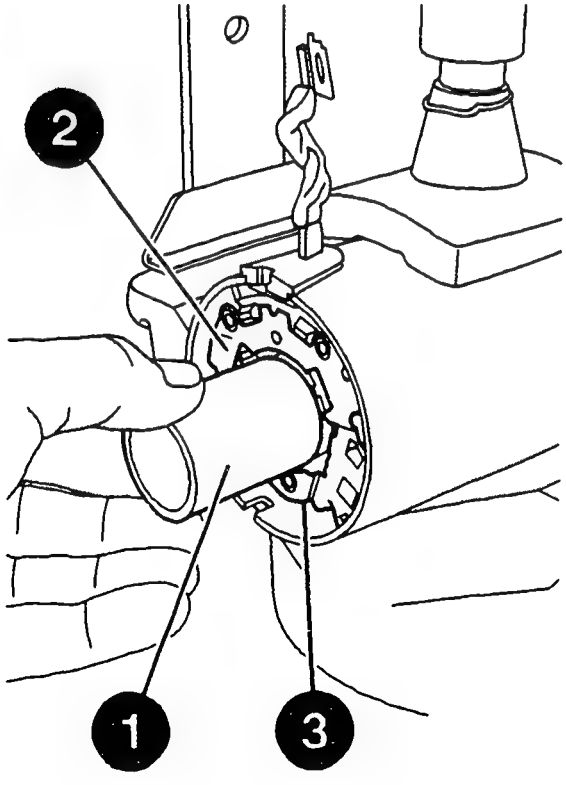
Assembling brush holder

Slip brush holder (2) with locating sleeve (1) onto armature shaft from commutator end.
Slip brush holder over commutator and remove locating sleeve.
Carbon brushes must rest on commutator.
Make sure locking device (3) is correctly positioned in stator frame.

Clamping support: 0 986 619 362

Continue: III07/1 Fig.: III22/2

KMS00444



STARTING MOTOR ASSEMBLY

Assembling commutator end shield

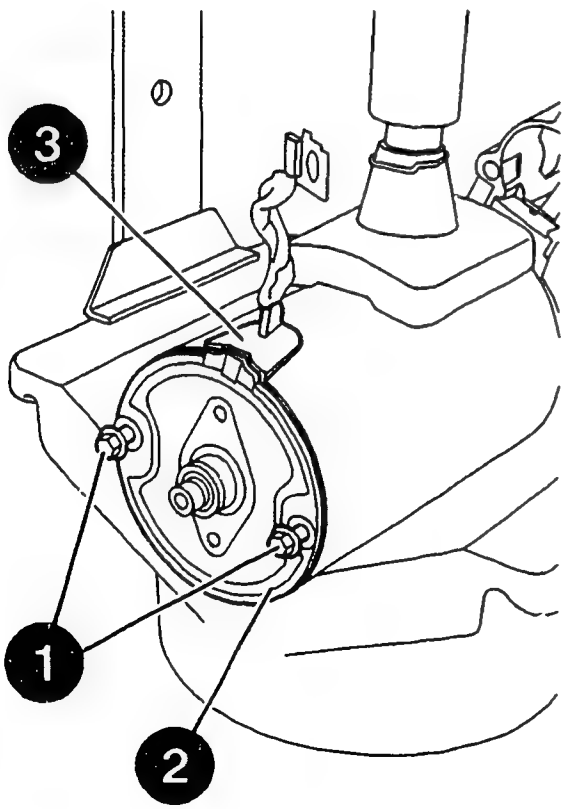
Position commutator end shield (2) on stator frame. Pay attention to correct positioning of end shield and seal (3). Slacken off clamping support, check positioning of drive-end bearing again and secure bolts (1). The bolts must run in parallel with the imaginary center axis of the starting motor. Use torque wrench.

Torque wrench: comm. avail.

Tightening torque: 5,5...6,0 Nm

Continue: III24/1 Fig.: III23/2

KMS00400



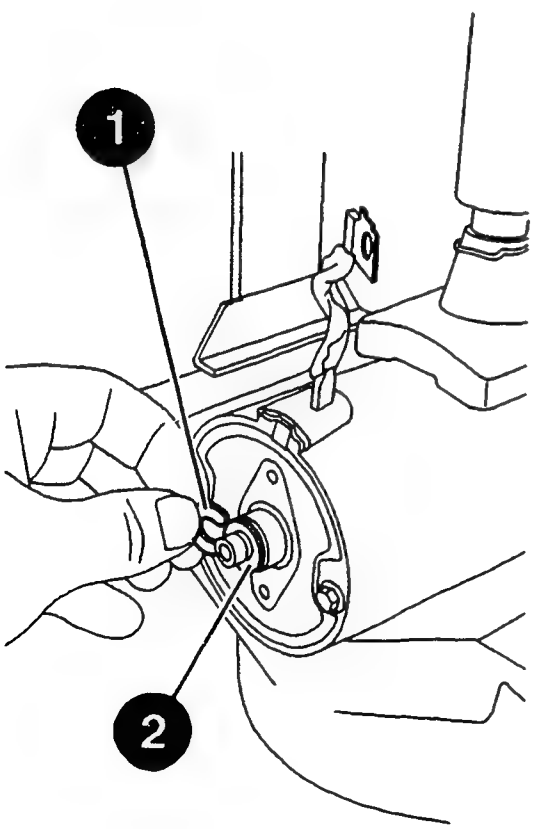
STARTING MOTOR ASSEMBLY

Assembling commutator end shield

Slip new shim (2) onto armature shaft and insert positioning washer (1) in annular groove.

Continue: III07/1 Fig.: III24/2

KMS00399



STARTING MOTOR ASSEMBLY

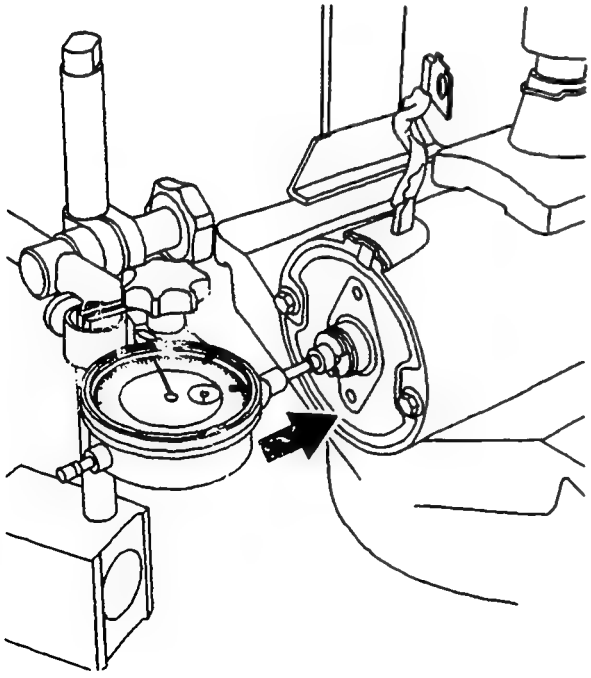
Checking and adjusting armature axial clearance

Push in armature as far as it will go in direction of drive-end bearing (arrow).

Apply dial gauge at end face of armature shaft and set it to "ZERO".

Continue: III26/1 Fig.: III25/2

KMS00447



STARTING MOTOR ASSEMBLY

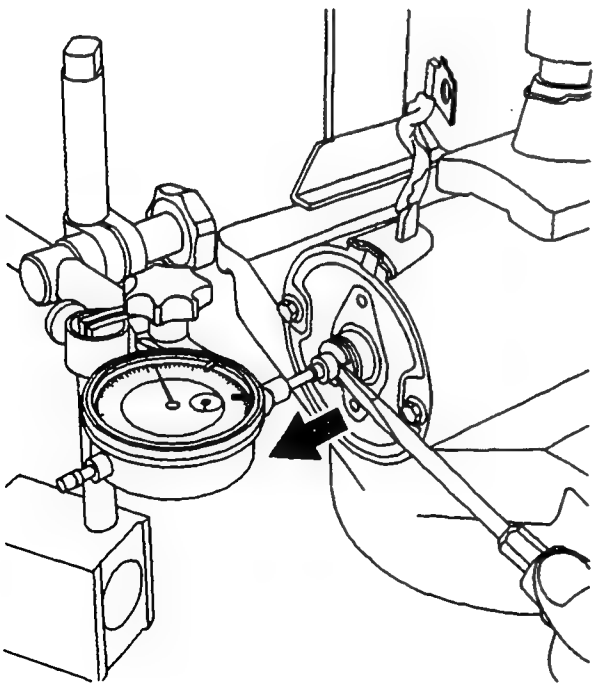
Checking and adjusting armature axial clearance

Move armature in direction of commutator end shield as far as it will go, read off armature axial clearance.
If armature axial clearance is outside stated range, adjustment must be made using an appropriate shim.
Then check armature axial clearance again.
Check freedom of movement of armature.

Armature axial clearance: 0,1...0,6 mm

Continue: III07/1 Fig.: III26/2

KMS00448



STARTING MOTOR ASSEMBLY

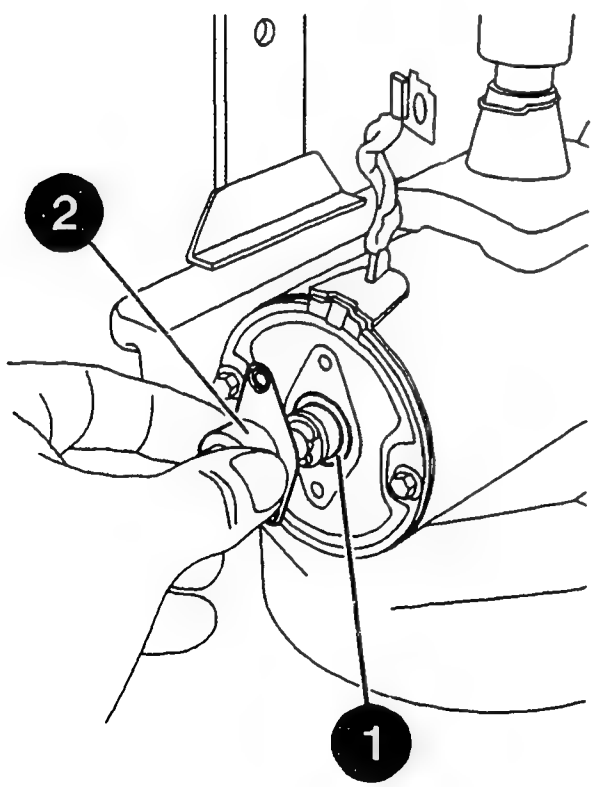
Assembling bearing end plate

Slip new gasket (1) onto commutator end shield.
Fill 1/3 of bearing end plate (2) with grease and secure.
Use torque wrench.

Torque wrench:	comm. avail.
Grease VS 18036 Ft:	5 997 098 000
Tightening torque:	1,5...2,0 Nm

Continue: III07/2 Fig.: III27/2

KMS00449



STARTING MOTOR ASSEMBLY

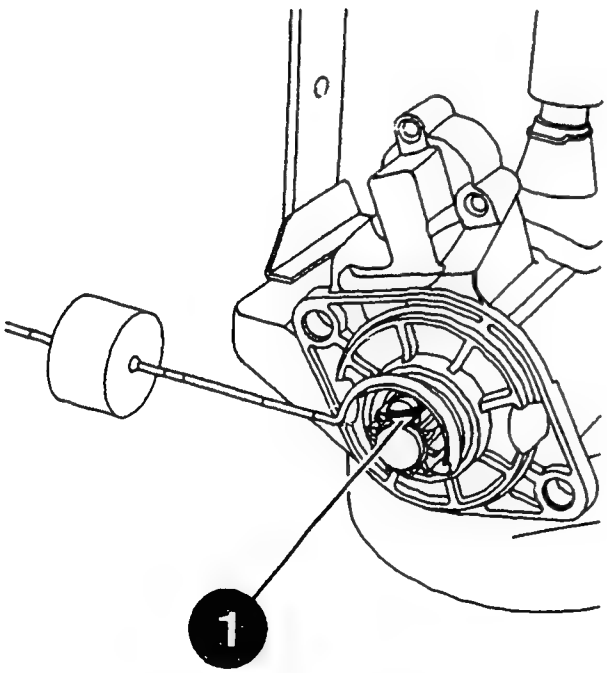
Checking armature braking torque

Insert bolt (1), for example, in pinion so as to ensure proper attachment of torque meter.
Suspend torque meter from pinion in line with direction of operation of starting motor and move to horizontal position.

Torque meter: 0 986 617 206

Continue: IV01/1 Fig.: III28/2

KMS00451



STARTING MOTOR ASSEMBLY

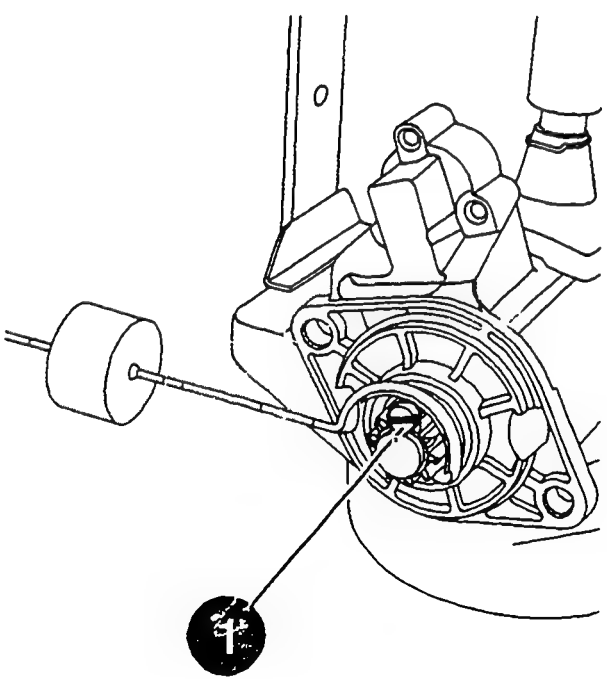
Checking armature braking torque

Shift weight until pinion starts to turn. Scale reading must be in range between "3,0"..."4,0", corresponding to a braking torque of 0,3...0,4 Nm.
ATTENTION: Torque meter must not make contact with drive-end bearing during test.

Armature braking torque: 0,3...0,4 Nm

Continue: III07/2 Fig.: IV01/2

KMS00451



STARTING MOTOR ASSEMBLY

Checking clutch overrunning torque

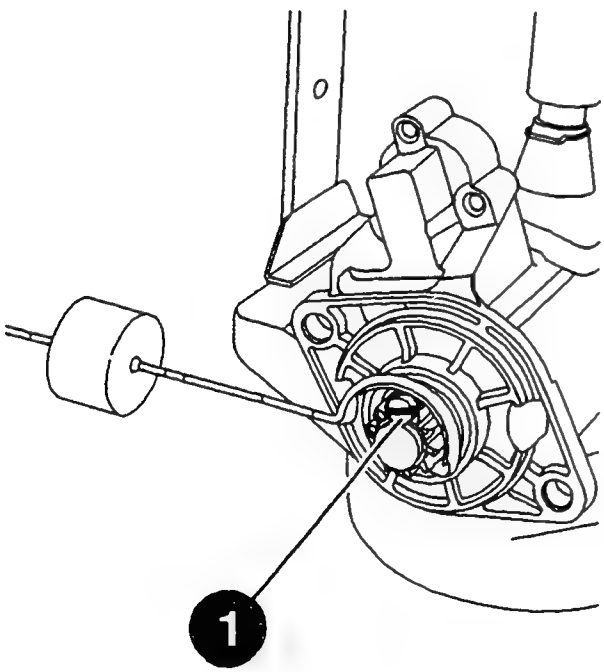
Insert bolt (1) or the like in pinion to guarantee proper attachment of torque meter.

Suspend torque meter from pinion in line with direction of operation of starting motor and move to horizontal position.

Torque meter: 0 986 617 206

Continue: IV03/1 Fig.: IV02/2

KMS00451



STARTING MOTOR ASSEMBLY

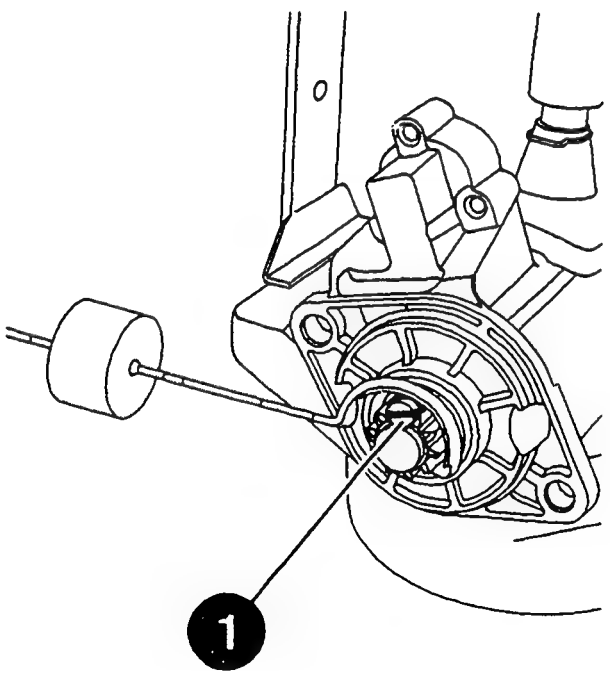
Checking clutch overrunning torque

Shift weight until pinion starts to rotate. The scale reading must be between "1,0"..."2,0", corresponding to an overrunning torque of 0,1...0,2 Nm.
ATTENTION: Torque meter must not make contact with drive-end bearing during test.

Clutch overrunning torque:	0,1...0,2 Nm

Continue: III07/2 Fig.: IV03/2

KMS00451



STARTING MOTOR ASSEMBLY

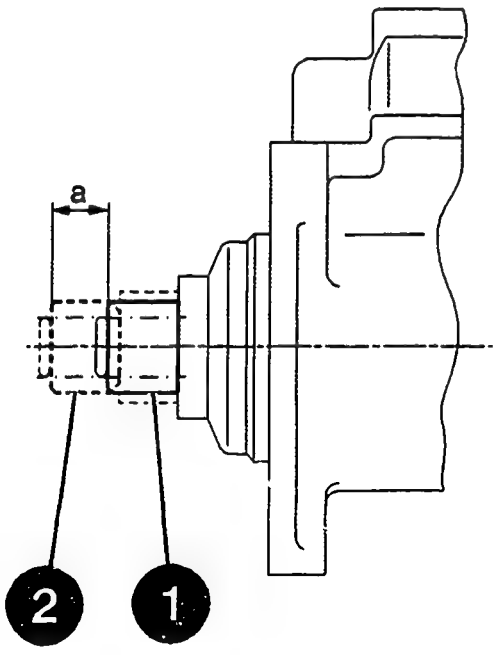
Checking total pinion travel

The total pinion travel is to be measured at the end face of the pinion between rest position (1) and end position (2) (fully meshed).

Vernier caliper:	comm. avail.
Total pinion travel a:	12...15 mm

Continue: III07/2 Fig.: IV04/2

KMS00452



STARTING MOTOR ASSEMBLY

Assembling solenoid switch

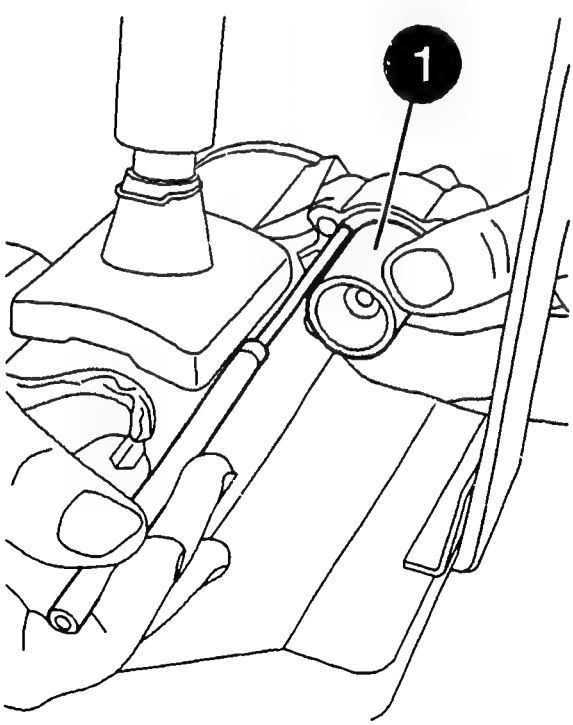
Use suitable tool to pull back engaging lever and engage solenoid switch armature (1) in engaging lever.

Apply small quantity of grease to periphery of switch armature. Pay attention to return spring in solenoid switch armature.

Grease VS 16634-Ft: 5 990 260 000

Continue: IV06/1 Fig.: IV05/2

KMS00397



STARTING MOTOR ASSEMBLY

Assembling solenoid switch

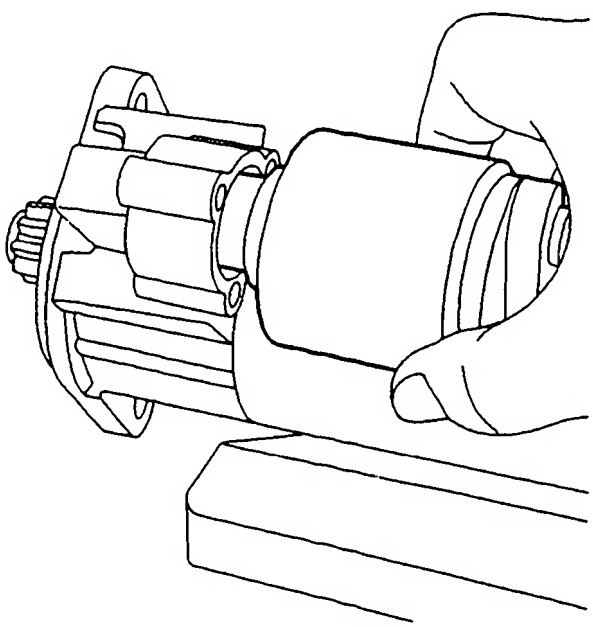
Slip on solenoid switch and attach to drive-end bearing.
Make sure return spring is properly positioned in solenoid switch.
Pay attention to mark.
Use torque wrench.
Apply approx. 0.5 g of Loctite 577 (5 994 090 000) to threads of bolts.

Torque wrench: comm. avail.

Tightening torque: 4,5...6,0 Nm

Continue: IV07/1 Fig.: IV06/2

KMS00396



STARTING MOTOR ASSEMBLY

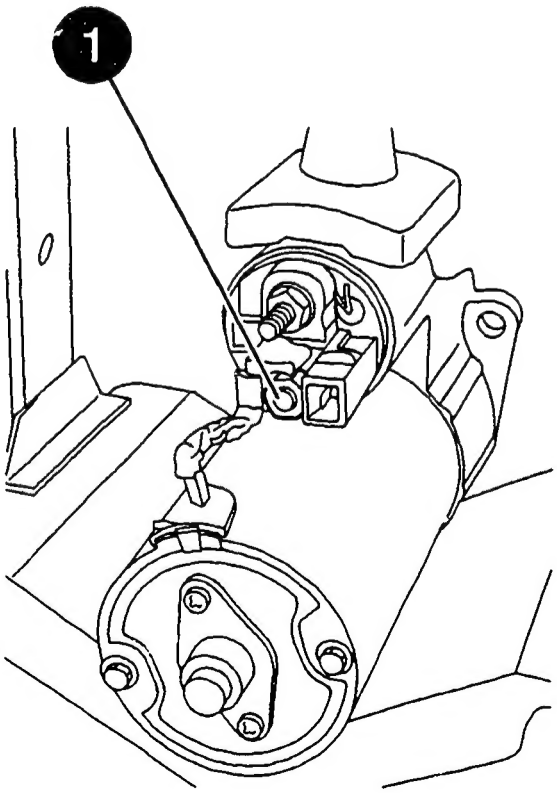
Assembling solenoid switch

Attach connection of brush holder (1) to solenoid switch, terminal 45. Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque, term. 45:	7...9 Nm

Continue: III07/2 Fig.: IV07/2

KMS00395



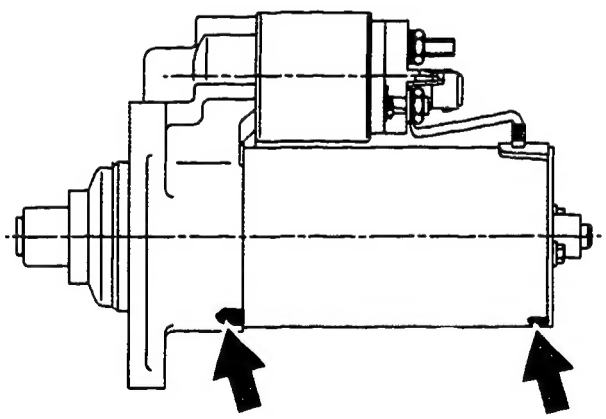
STARTING MOTOR ASSEMBLY

Painting starting motor
If starting motor is painted after assembly, make sure that paint does not ingress into the interior of the starting motor through the vent holes (see arrows) in the stator frame and drive-end bearing.

Seal off vent holes before painting. Always re-open vent holes after painting so as to ensure proper functioning of starting motor.

Continue: III07/2 Fig.: IV08/2

KMS00453



EDITORIAL NOTE

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Continue: IV09/2

EDITORIAL NOTE

Continue: I01/1